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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 246

SURFACE WATER SUPPLY OF THE UNITED STATES

1907–8

PART VI. MISSOURI RIVER BASIN

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

ROBERT FOLLANSBEE AND J. E. STEWART

WASHINGTON
GOVERNMENT PRINTING OFFICE
1910

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CONTENTS.

	Page.
Introduction	7
Authority for investigations	7
Scope of investigations	8
Purposes of the work	9
Publications	10
Definition of terms	13
Convenient equivalents	14
Explanation of tables	15
Field methods of measuring stream flow	16
Office methods of computing and studying discharge and run-off	21
Accuracy and reliability of field data and comparative results	27
Use of the data	28
Cooperation and acknowledgments	29
Division of work	29
Missouri River drainage basin	30
General features	30
Missouri River proper	31
Description	31
Red Rock River at Lima, Mont	33
Beaverhead River at Barratts, Mont	34
Beaverhead River at Dillon, Mont	37
Missouri River at Cascade, Mont	38
Missouri River near Williston, N. Dak	41
Prickly Pear Creek drainage basin	43
Description	43
Prickly Pear Creek near Clancy, Mont	43
Prickly Pear Creek at East Helena, Mont	44
Lump Gulch Creek near Clancy, Mont	45
Tenmile Creek near Helena, Mont	46
Sevenmile Creek near Helena, Mont	47
Dearborn River drainage basin	48
Description	48
Dearborn River near Clemons, Mont	48
Falls Creek near Clemons, Mont	49
Smith River drainage basin	50
Smith River at Truly, Mont	50
Sun River drainage basin	52
Description	52
North Fork of Sun River near Augusta, Mont	53
Sun River at Sun River, Mont	56
South Fork of Sun River at Augusta, Mont	60
Willow Creek near Augusta, Mont	63
Ford Creek near Augusta, Mont	66
Smith Creek near Augusta, Mont	69

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Missouri River drainage—Continued. Page.
Marias River drainage basin ... 72
Description ... 72
Cutbank Creek at Cutbank, Mont ... 73
Marias River near Shelby, Mont ... 76
Two Medicine River at Family, Mont ... 79
Badger Creek near Family, Mont ... 82
Birch Creek near Dupuyer, Mont ... 85
Dupuyer Creek at Dupuyer, Mont ... 87
Teton River near Belleview, Mont ... 89
Musselshell River drainage basin ... 91
Description ... 91
North Fork of Musselshell River near Martinsdale, Mont ... 92
Musselshell River at Harlowton, Mont ... 94
Musselshell River at Shawmut, Mont ... 97
South Fork of Musselshell River near Martinsdale, Mont ... 98
American Fork near Harlowton, Mont ... 100
Lebo Creek near Harlowton, Mont ... 103
Milk River drainage basin ... 104
Description ... 104
South Fork of Milk River near Browning, Mont ... 106
Milk River at Havre, Mont ... 108
Milk River at Malta, Mont ... 113
Milk River at Hinsdale, Mont ... 116
West Fork of Milk River at Chinook, Mont ... 117
North Fork of Milk River near Chinook, Mont ... 120
Beaver Creek near Ashfield, Mont ... 123
Beaver Creek Overflow near Bowdoin, Mont ... 124
Rock Creek near Hinsdale, Mont ... 125
Porcupine Creek at Nashua, Mont ... 126
Private canals in Milk River valley ... 127
Description ... 127
Paradise Valley canal near Chinook, Mont ... 128
Cook canal near Chinook, Mont ... 129
Matheson canal near Chinook, Mont ... 131
Harlem canal near Zurich, Mont ... 132
Agency ditch near Harlem, Mont ... 133
Fort Belknap canal near Chinook, Mont ... 134
Winter-Anderson canal near Chinook, Mont ... 136
Rock Creek canal near Hinsdale, Mont ... 137
Little Porcupine Creek drainage basin ... 138
Little Porcupine Creek near Frazer, Mont ... 138
Wolf Creek drainage basin ... 139
Wolf Creek at Wolf Point, Mont ... 139
Poplar Creek drainage basin ... 140
Poplar Creek near Poplar, Mont ... 140
Big Muddy River drainage basin ... 141
Big Muddy River near Culbertson, Mont ... 141
Yellowstone River drainage basin ... 141
Description ... 141
Yellowstone River at Huntley, Mont ... 144
Yellowstone River at Junction, Mont ... 146
Yellowstone River at Glendive, Mont ... 148
North Fork of Big Timber Creek near Big Timber, Mont ... 151

Digitized by Google

Missouri River drainage—Continued.
Yellowstone River drainage basin—Continued. Page.
South Fork of Big Timber Creek near Big Timber, Mont 153
East Fork of Boulder River near McLeod, Mont 156
West Fork of Boulder River near Bruffeys, Mont 158
West Fork of Boulder River at McLeod, Mont 163
Sweetgrass Creek above Melville, Mont 165
Sweetgrass Creek below Melville, Mont 169
Clark Fork at Fromberg, Mont 172
Pryor Creek at Huntley, Mont 175
Bighorn River drainage basin 178
Description 178
Big Wind River near Riverton, Wyo 180
Bighorn River near Hardin, Mont 182
Little Wind River at Fort Washakie, Wyo 185
Little Wind River above Arapahoe, Wyo 186
Little Wind River below Arapahoe, Wyo 189
Little Popo Agie River at Hudson, Wyo 191
Shoshone River at Cody, Wyo 194
Shoshone River at Corbett Dam, Wyo 197
South Fork of Shoshone River at Marquette, Wyo 199
Little Muddy River drainage basin 201
Description 201
Little Muddy River near Williston, N. Dak 202
Little Missouri River drainage basin 205
Description 205
Little Missouri River at Medora, N. Dak 206
Knife River drainage basin 209
Description 209
Knife River at Broncho, N. Dak 210
Heart River drainage basin 214
Description 214
Heart River near Richardton, N. Dak 214
Cannon Ball River drainage basin 217
Description 217
Cannon Ball River at Stevenson, N. Dak 217
Grand River drainage basin 220
North Fork of Grand River near Haley, N. Dak 220
Niobrara River drainage basin 221
Description 221
Niobrara River near Spencer, Nebr 222
Platte River drainage basin 223
General features 223
North Platte River drainage basin 223
Description 223
North Platte River at Pathfinder, Wyo 227
North Platte River at Guernsey, Wyo 230
North Platte River near Mitchell, Nebr 234
North Platte River at North Platte, Nebr 237
Platte River drainage basin 241
Description 241
Platte River at Columbus, Nebr 242
Loup River at Columbus, Nebr 245

Digitized by Google

Missouri River drainage—Continued.
Platte River drainage basin—Continued.
South Platte River.
Page.
Description. 247
South Fork of South Platte River at South Platte, Colo. 247
South Platte River at South Platte, Colo. 251
South Platte River near Kersey, Colo. 255
South Platte River near Julesburg, Colo. 259
North Fork of South Platte River at Cassels, Colo. 265
Geneva Creek near Grant, Colo. 268
Clear Creek at Fidelscreek, Colo. 269
Boulder Creek at Orodell, Colo. 271
Boulder Creek near Boulder, Colo. 275
Kansas River drainage basin. 278
Description. 282
Republican River at Bostwick, Nebr. 282
Little Blue River near Fairbury, Nebr. 284
Gasconade River drainage basin. 287
Description. 290
Piney Fork of Gasconade River near Houston, Mo. 290
Miscellaneous measurements in Missouri River drainage basin. 291
Index. 291
297

ILLUSTRATIONS.

Page.
PLATE I. *A*, Current-meter rating station at Los Angeles, Cal.; *B*, Bridge station and cross section of stream illustrative of 0.2 and 0.8 depth method. 18
II. Price penta-recording current meters. 20
III. Kepler Cascade, Firehole River. 30
IV. *A*, Sun River canyon above point of diversion. *B*, Sun River canyon diversion site, Sun River project, Montana. 52
V. Lower Falls of the Yellowstone. 142
VI. *A*, Main canal, Huntley project, Montana; *B*, Pryor Creek weir during spring flood, Huntley project, Montana. 144
VII. Portion of completed main canal, lower Yellowstone project, Montana. 148
VIII. *A*, Shoshone dam, Wyoming; *B*, Shoshone dam site, Wyoming. 180
IX. *A*, Box Canyon immediately below Shoshone dam site; *B*, Corbett tunnel, Corbett diversion dam, Shoshone project, Wyoming. 196
X. *A*, Pathfinder dam; *B*, Pathfinder dam site before construction, North Platte project, Nebraska-Wyoming. 224
XI. *A*, Interstate canal wasteway at Mollies Fork, North Platte project, Nebraska-Wyoming; *B*, Grain field under the Interstate canal, North Platte project, Nebraska-Wyoming. 226
XII. *A*, Portion of Elkhorn reservoir site on Cache la Poudre River; *B*, Continental Divide near Tolland, Colo. 250
A, Diversion dam, Belle Fourche project, South Dakota; *B*, Diversion dam and head-gates, Belle Fourche project, South Dakota. 282
Gage curves of Smith Creek near Augusta, Mont. 23
Gage curves of Marias River near Shelby, Mont. 24

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SURFACE WATER SUPPLY OF THE MISSOURI RIVER BASIN, 1907-8.

By ROBERT FOLLANSBEE and J. E. STEWART.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000

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SCOPE OF INVESTIGATIONS.

These investigations are not complete, nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited to that which can be provided with the appropriations available. The field covered and the character of the work are believed to be the best that could be accomplished under the controlling conditions. It would undoubtedly be of more scientific importance and ultimately of more practical value if the money now applied to wide areas were concentrated on a few small basins. Such a course is impossible, because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be maintained during a period of years sufficient to cover all stages, in order that within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum may be determined. The length of such a period manifestly varies for different streams and can not be absolutely determined. Experience has shown that the records should cover from five to ten years, or for some streams twenty years or more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work the Geological Survey endeavors to approach as nearly as possible the highest degree of precision which a rational expenditure of time and a judicious expenditure of a small amount of money will allow. In all engineering work there is a point of refinement beyond which it is needless and wasteful to proceed, and this principle applies with especial force to stream-flow measurements. It is confidently believed that with some unavoidable exceptions the stream-flow data presented in the publications of the Survey are sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of many stations. All persons are cautioned to exercise the greatest care in the utilization of such incomplete records.

Records of varying lengths have been obtained at about 1,400 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1907 and 1908 regular gaging stations were maintained by the Survey and cooperating [illegible]vations at about 740 points in the United States, and in addi[illegible]nerous miscellaneous measurements were made. Data were [illegible]ained in regard to precipitation, evaporation, storage reser[illegible]r profiles, and water power in many sections of the country.

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These data will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

Among the purposes for which the results contained in this volume are requisite are navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention. The demands of all these interests are immediate.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $42,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system is based absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are of first importance in the redemption of the lands, as well as constituting an insurance of federal and private investments.

Domestic water supply.—The highest use of water is that of domestic supply, and while the federal interest in this aspect of the matter is less direct than in the aspects already named this use of water nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The time is rapidly approaching when the development of the water power of the country will be an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industry will cease its growth if cheap power is not available, and in that event the United States as a nation will cease to progress. Water power is the only avenue now open. When the electric transmission of power was accomplished, the relation of our water powers to national economy changed entirely. Previous to the day of electric transmission the importance of a water power was largely confined to the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available is dependent on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless, or of precarious value, by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would

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add to the national assets at least $[illegible]. The study of run-off is the first consideration in connection with drainage projects. If, by the drainage of a large area into any particular channel, that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States exceeds $100,000,000 annually, and in the year 1[illegible] the aggregate damage, based on reliable data, approximated $[illegible]. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications has varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts, whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface-water supply for 1907 and 1908. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface water supply of the United States, 1907–8.

Part.	No.	Title.
I	201	North Atlantic coast.
II	202	South Atlantic coast and eastern Gulf of Mexico.
III	203	Ohio River basin.
IV	204	St. Lawrence River basin.
V	205	Upper Mississippi River and Hudson Bay basins.
VI	206	Missouri River basin.
VII	207	Lower Mississippi River basin.
VIII	208	Western Gulf of Mexico.
IX	209	Colorado River basin.
X	210	Great Basin.
XI	211	California.
XII	212	North Pacific coast.

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The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey exclusive of all special papers. Numbers of reports are inclusive, and dates also are inclusive, so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Years
16th Ann., pt. 2	Descriptive information only	
17th Ann., pt. 2	Monthly discharge	1884 to March, 1896.
18th Ann., pt. 2	do	1884 to June 30, 1897.
19th Ann., pt. 3	Mean discharge in second-feet	1884 to June 30, 1898.
20th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1902)	1898 to June 30, 1899.
[illegible]	Descriptions, measurements gage heights, and rainfall	1896 and 1896.
20th Ann., pt. 2	Descriptive information only.	
[illegible]	Descriptions, measurements gage heights, rainfall, and monthly discharge and many data previously published	1897.
[illegible]	Gage heights and gage heights for earlier years	1898.
21st Ann., pt. 4	Descriptions, measurements, rainfall, and monthly discharge and mean data for earlier years	1898, and 1899.
[illegible]	Descriptions, measurements, and gage heights, stations in Missouri, chiefly Missouri River and Missouri River tributaries in Kansas	1897
[illegible]	Descriptions, measurements, and gage heights, stations in Missouri, chiefly in the Ozark region and Mississippi River tributaries	1897
20th Ann., pt. 4	Descriptions, measurements, gage heights, and monthly discharge	1897
[illegible]	Measurements, gage heights, and monthly discharge, Missouri River and tributaries	1898
[illegible]	Measurements, gage heights, and monthly discharge, Mississippi River and tributaries	1898
20th Ann., pt. 4	Measurements, gage heights, and monthly discharge	1898
[illegible]	Descriptions, measurements, gage heights, and monthly discharge	1898
20th Ann., pt. 4	Measurements, gage heights, and monthly discharge	1898
[illegible]	Descriptions, measurements, gage heights, and monthly discharge	1898
[illegible]	Measurements, gage heights, and monthly discharge	1898
[illegible]	Descriptions, measurements, gage heights, and monthly discharge	1898
[illegible]	Measurements, gage heights, and monthly discharge	1898
[illegible]	do	1898
[illegible]	do	1898
[illegible]	Descriptions, measurements, gage heights, and monthly discharge	1898
[illegible]	Measurements, gage heights, and monthly discharge	1898

[illegible]

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[illegible] 1899–1908.

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	3	4	6.7	6	9	128	146	201	241
[illegible]	3	4	6.7	6	9	125	146	202	241
[illegible]	3	4	6.7	6	9	128	147	203	241
[illegible]	3	4	6.7	6	9	128	147	203	242
[illegible]	3	4	6.7	6	9	[illegible]	[illegible]	204	242
[illegible]	3	4	6.7	6	9	[illegible]	[illegible]	205	244
[illegible]	[illegible]	[illegible]	6.7	6	188	238	[illegible]	205	245
[illegible]	3	4	6.7	6	9	128	149	205	243
[illegible]	3	4	6.7	6	9	[illegible]	[illegible]	205	245
[illegible]	[illegible]	[illegible]	6.7	6	9	[illegible]	172	206	246
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	(205), 209	247
[illegible]	[illegible]	[illegible]	6.7	6	9	[illegible]	174	210	248
[illegible]	3	4	6.7	6	188	[illegible]	[illegible]	211, (213)	249, (251)
[illegible]	3	4	6.7	6	188	[illegible]	[illegible]	[illegible] (213)	250, (251)
[illegible]	3	4	6.7	6	188	234	[illegible]	213	251
[illegible]	3	4	6.7	6	188	235	[illegible]	214	252

[illegible] Paper 39.
[illegible] data as precipitation, wells, and irrigation

[illegible] *drainage basins.*

	Tributaries included.
[illegible]	[illegible]
[illegible]	[illegible] above junction with Gunnison.
[illegible]	[illegible]
[illegible]	[illegible] Neb. All tributaries below
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the stations in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream [illegible] is expressed in various terms, each of which has a particular relation with a certain class of work. These terms are [illegible] in the principal [illegible]. The [illegible] is expressed [illegible] by the mean [illegible] square mile, and [illegible] is [illegible] if water is measured in depth in inches and hundredths. They are defined as follows:

[illegible]

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CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons per one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.011 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 1.9835 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.961 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.979 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.48 acre-feet.
100 California miner's inches equal 2.5 second-feet.
100 California miner's inches equal 2.5 United States gallons per second.
100 California miner's inches equal 96.3 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 2.5 United States gallons per second.
100 Colorado miner's inches equal 1.04 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.2737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 208 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals
1 cubic foot of wa
1 cubic meter pe d-foot.
1 horsepower equ
1 horsepower equ
1 horsepower equ

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1 horsepower equals 1 second-foot falling 8.80 feet.

1½ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, rating table, table of monthly and yearly discharge, and [illegible]. For stations located at weirs or dams the gage-height [illegible] are omitted and a table of daily [illegible]. For stations where the flow is computed [illegible] a table of daily discharge is given in place of [illegible] not used in these methods of computation.

In addition to statements regarding [illegible] of current-meter stations the descriptions [illegible] to any conditions which may affect [illegible] gage height to discharge, covering [illegible] conditions of flow, and [illegible] diversions which decrease the total [illegible] statements are also made regarding [illegible] the data.

The discharge measurements [illegible] measurements made during the [illegible] hydrographer, with [illegible] discharge in second-feet.

The table of daily gage heights [illegible] the surface of the river as [illegible] then each day. In most stations [illegible] at in the evening. The gage [illegible] fluctuations of the surface of the [illegible] of gage heights during an [illegible] are published as nearly [illegible] for each person [illegible] known and con- [illegible] the gage is [illegible] or the [illegible] that [illegible] [illegible]

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The discharge measurements and gage heights are the base data from which the rating tables and monthly-discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is published to enable engineers to determine the daily discharge by its application to the table of gage heights or to check results in the table of monthly discharge.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the period when the water surface was at crest height and the corresponding discharge consequently larger than given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 13, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope [illegible] marks along the bank, and a knowledge of the general [illegible] dom used by the United States Geological S[illegible] mation regarding this method the reader is [illegible] books on hydraulics.

[illegible] maintained at weirs or dams by [illegible] vey. Standard types of [illegible] fix the limits for which

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accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, crest which is not level, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others, depending on the type of development and the uses of the diverted water.

In general, records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams and where the conditions are reasonably favorable are practically as good as those obtained at standard weirs.

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Great care is taken in the selection and equipment of gaging stations for determining discharge by current measurements, in order that the data may have the required degree of accuracy. They are located as far as possible at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight smooth section without cross currents, backwater from dams, or at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough permanent sections if measurements are properly made by experienced engineers using measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semipermanent or shifting sections with smooth, uniform current. So far as possible, stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, B.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between pier[illegible]ther apart than the approximate mean depth at the

[illegible]ts divide the total cross section into elementary
[illegible]servations of depth and velocity
[illegible]elementary strip is the product
[illegible]two ends times the width of the
[illegible]velocities at the two ends of the

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A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.

B. BRIDGE STATION AND CROSS SECTION OF STREAM

showing C 1 and C 8 gage rods

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strip. The sum of the discharges of the elementary strips is the total discharge of the stream. (For a discussion of methods of computing the discharge of a stream, see Engineering News, June 25, 1908.)

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method, with its various modifications of surface, subsurface, and tube or rod floats, is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity. For further information regarding this method the reader is referred to Water-Supply Paper 95 and to the various text-books covering the general subject of stream flow.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions. Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations. On the sides the same type of meter is shown equipped for wading measurements to record by the acoustic method on the left and by the electric method on the right. Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The number of revolutions is indicated electrically. The rating, or relation between the velocity of the moving water and the revolution of the wheel, is determined for each meter by drawing it through still water for a given distance

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at different speeds and noting the number of revolutions for each run. (See Pl. I, A.) From these data a rating table is prepared which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 [illegible]. In general practice the thread of mean velocity is co[illegible] at 0.6 depth, and at this point the meter is held in m[illegible] measurements made by the single-point method. A

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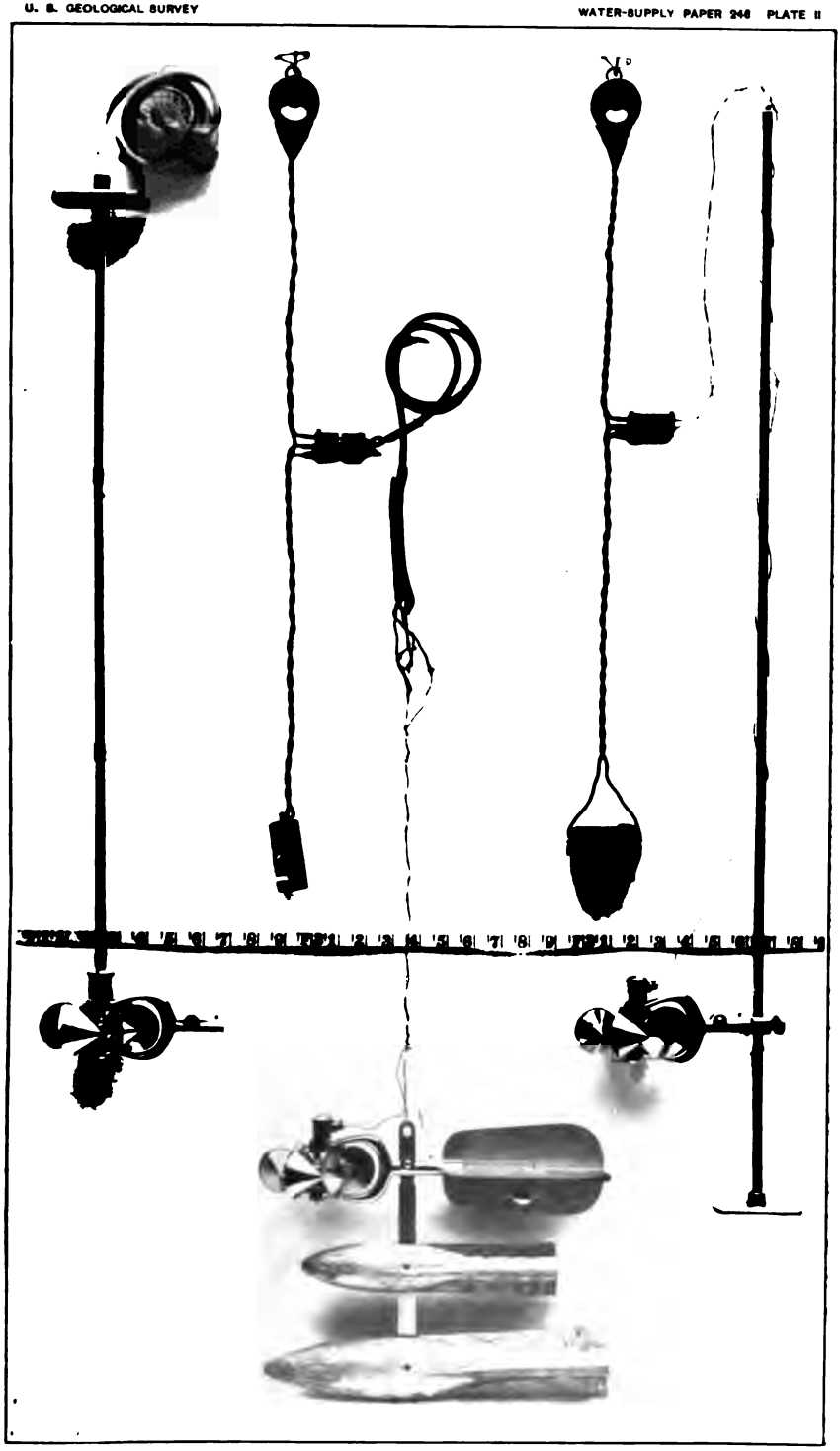

PRICE PENTA-RECORDING CURRENT METERS.

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large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover, see Water-Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible.

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The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 17.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements.

For every published rating table the following assumptions are made for the period of application of the table: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated, the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface, the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve and the rating developed from that curve represents a very high degree of accuracy. For illustrative example of a station of this type see Water-Supply
241.

2 is confined mainly to stations on rough mountainous streams
ep slopes. The beds of such streams are as a rule compara-

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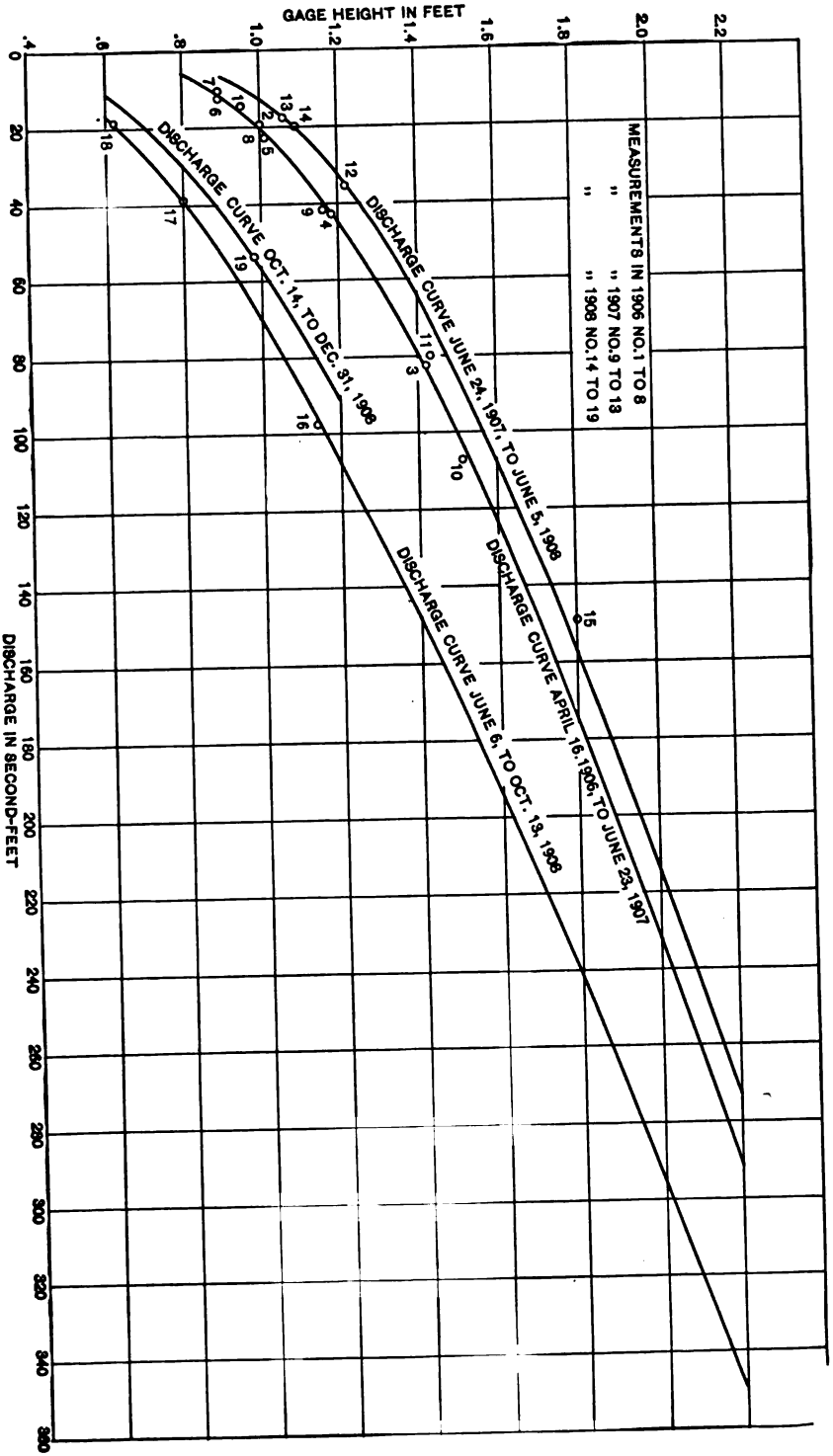

FIGURE 1.—Discharge curves of Smith Creek near Augusta, Mont.

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tively permanent during low and medium stages and when the flow is sufficiently well defined by an adequate number of discharge measurements before and after each flood the stations of this class

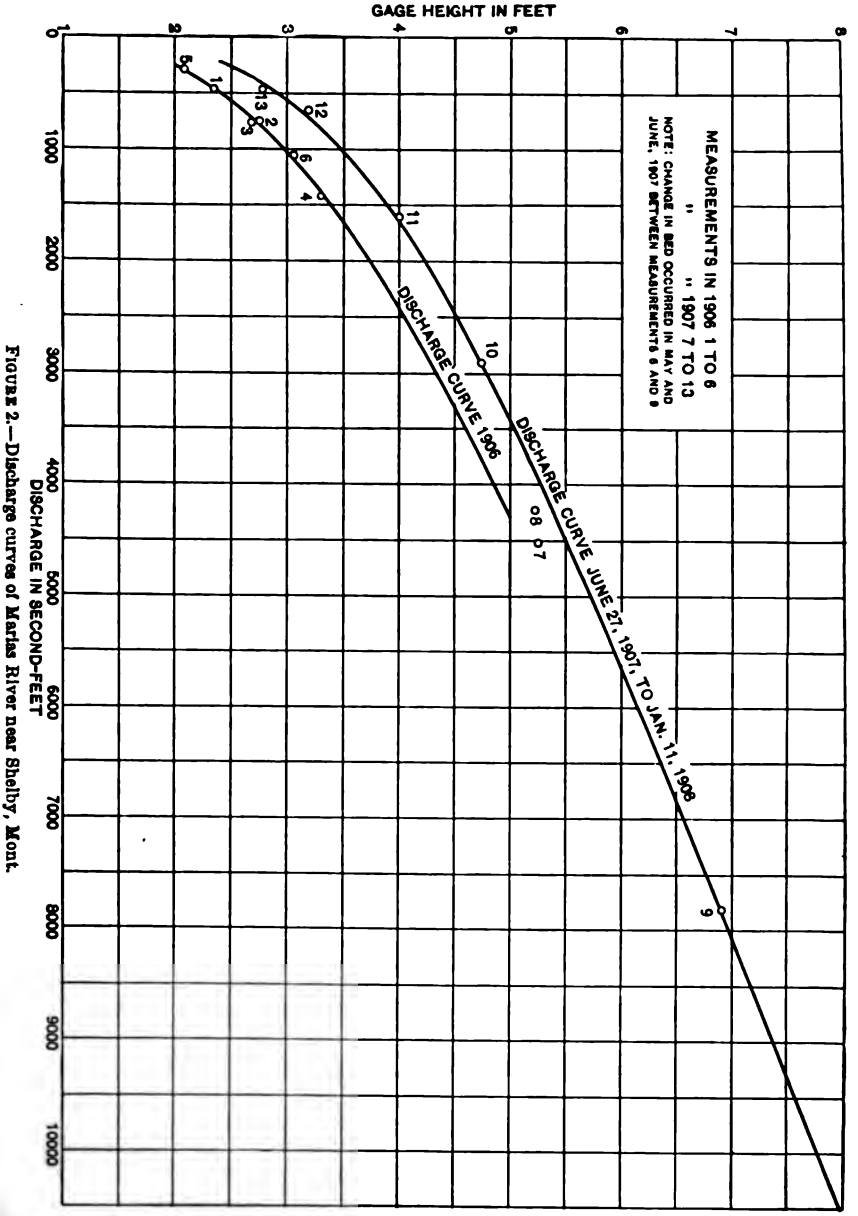
GAGE HEIGHT IN FEET
DISCHARGE IN SECOND-FEET
MEASUREMENTS IN 1906 1 TO 6
" " 1907 7 TO 13
NOTE: CHANGE IN BED OCCURRED IN MAY AND JUNE, 1907 BETWEEN MEASUREMENTS 6 AND 8
DISCHARGE CURVE 1906
DISCHARGE CURVE JUNE 21, 1907, TO JAN. 11, 1908

FIGURE 2.—Discharge curves of Marias River near Shelby, Mont.

nearly as good results as those of class 1. (See figs. 1 and 2.) is seldom possible to make measurements covering the time of e at flood stage, the assumption is often made that the curves

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before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are as a rule at relatively high or low stages. The percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve, which may be called a standard curve. It has been found in practice that if after a change caused by high stage a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to their ordinates or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct but, with few exceptions, answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in the channel caused by cut, or fill, or both, at and near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

a. If 5 feet of planking were to be nailed on the bottom of a [illegible] wooden flume of rectangular section, there would result, other conditions of flow being equal, new curves of gage area, and velocity, each plotting 0.5 foot above the original curves with reference to the original gage. In [illegible] be applied to a [illegible] reduces or increases [illegible] for any gage height. In practice [illegible] rarely exist.

b. In the case of a [illegible] marked tendency toward [illegible]

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velocity. In other words, the velocity has a compensating effect and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(c) In the case of uniform change along the crest of a weir or rocky controlling point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another, and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. For illustrative example of a station of this type see Water-Supply Paper 242.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is assumed that the rate of change is uniform and hence the ratings for the intervening days are equally spaced between the ratings using through the two measurements. This method must be [illegible] and a knowledge of the conditions involved can

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alone dictate the course to pursue in such cases. For illustrative example of a station of this type, showing the Bolster method of determining the daily discharge graphically, see Water-Supply Papers 247 and 249.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the monthly discharge tables.

For most of the northern stations estimates have been made of the monthly discharge during frozen periods. These are based on measurements under ice conditions wherever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule included in the annual discharge. The large error of the individual months has a relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from

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supervision of W. B. Freeman, district engineer, but under the immediate direction of Adna Dobson, state engineer, assisted by A. A. Dobson, G. W. Bates, and other employees of the state engineer's office.

The ratings, special estimates, and studies of the completed data were made by Robert Follansbee and J. E. Stewart for Montana, and W. B. Freeman and F. F. Henshaw for Wyoming, Colorado, and Nebraska. The computations and the preparations of the completed data for publication were made by G. C. Stevens, R. C. Rice, J. G. Mathers, H. D. Padgett, and M. I. Walters. The manuscript was edited by Mrs. B. D. Wood.

MISSOURI RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Missouri River and its innumerable tributaries drain an immense area in the northern and western section of the United States. The northern boundary of this area is approximately the fiftieth parallel, the southern the thirty-ninth; to the west it is limited by the Rocky Mountains, while to the east the divide between it and the upper Mississippi basin crosses eastern North and South Dakota, western Iowa, and northeastern Missouri. Its extent east and west is about 1000 miles; north and south it is 600 miles; and it comprises a total of 492,000 square miles.

The topography of the basin is of the most varied character, ranging from the mountainous regions of Montana, Wyoming, and Colorado to the rolling prairies of the Dakotas, Nebraska, and Kansas. The upper tributaries drain a forested region, but the main stream flows through a country almost wholly devoid of forests. The precipitation in the mountainous portion of the basin is mainly in the form of snow, but a great part of the area lies within the arid and semiarid regions, and it is probable that the annual average precipitation throughout the entire basin is less than 20 inches.

The tributaries are mostly in the upper course of the river and from the western side of the basin. The most important of these are Musselshell, Sun, Marias, Milk, Yellowstone, Cheyenne, Platte, and Kansas rivers.

On account of the high altitude and northern climate ice conditions prevail in the upper portions of this basin from November to April. The Missouri itself thaws over entirely, but many of its tributaries remain partly open on account of the extreme rapidity of the water. The amount of snow [illegible] in the mountains is usually small, but [illegible] late, and accumulates to great depths.

Irrigation is practiced [illegible] the various tributaries [illegible] developed in

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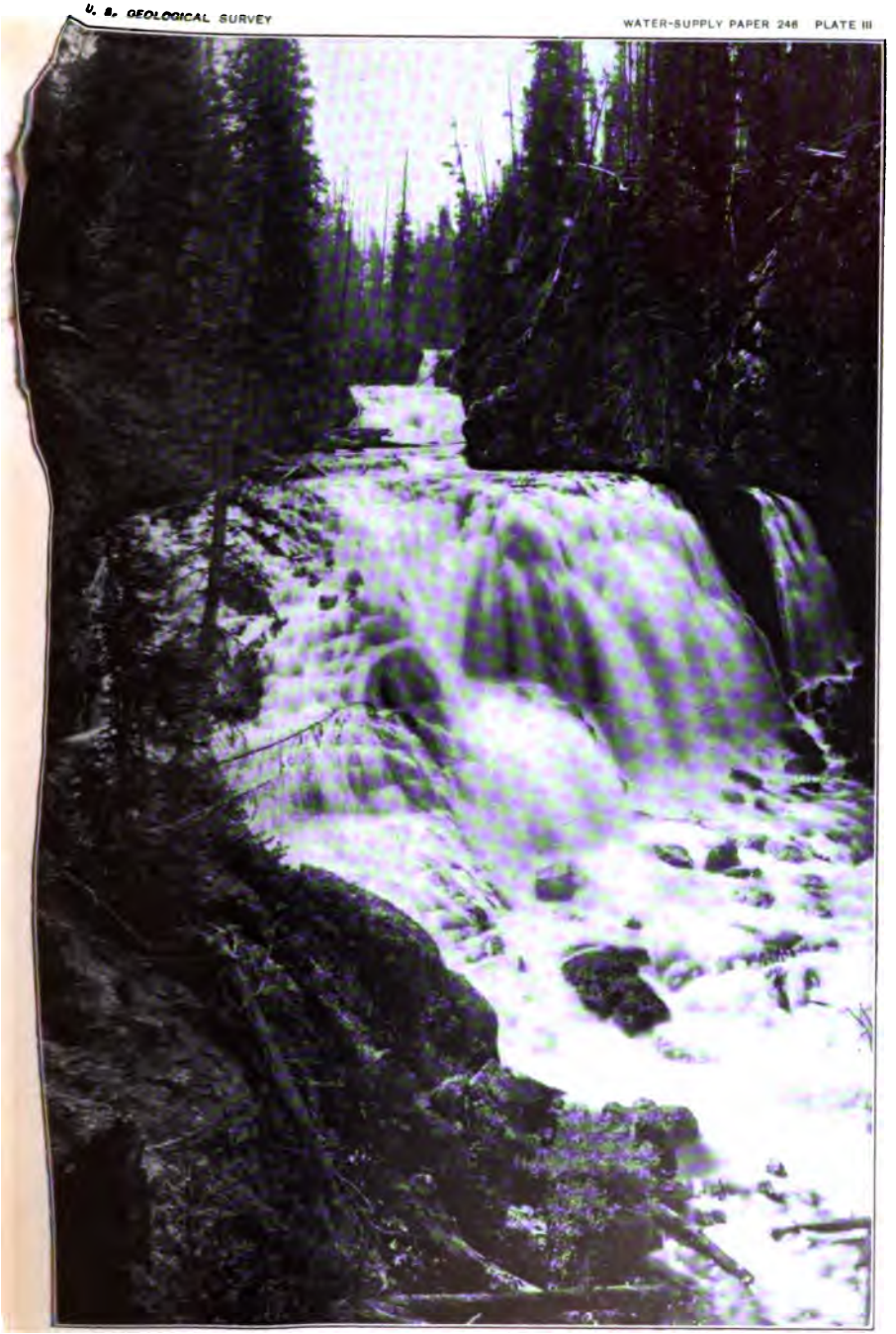

KEPLER CASCADE, FIREHOLE RIVER, YELLOWSTONE NATIONAL PARK.

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many of the valleys. The Madison and Gallatin and many other of the mountain tributaries afford unsurpassed storage facilities, the waters of the Beaverhead, Big Hole, Madison, Jefferson, and Gallatin rivers furnish great supplies for irrigation, and the basins of Milk, Sun, Yellowstone, and Musselshell rivers, already extensively utilized, still offer opportunities for broader irrigation, storage, and water-power development. (See Pls. III and XIII.)

MISSOURI RIVER PROPER.

DESCRIPTION.

Missouri River proper is formed in southwestern Montana by the union of three streams, which were discovered by Lewis and Clark in 1806 and named by them Jefferson, Madison, and Gallatin rivers. Jefferson and Madison forks come together first, and within 2 miles they are joined by the Gallatin. The head of the Missouri thus formed lies in about latitude 45° 56′ north and longitude 111° 32′ west. Each of the three headwater rivers is about 90 feet wide, flows with great velocity, and discharges large quantities of water. The Gallatin is the most rapid of the three, but the Jefferson drains the largest area, and is here treated as the continuation of the main river. The Jefferson itself is formed by the union of two forks—Big Hole and Beaverhead rivers—the Beaverhead draining the larger area and having as its master headwater stream Red Rock River. The source of this last-named river—the Red Rock lakes, lying in the Rocky Mountains 6,700 feet above sea level—may, therefore, be regarded as the ultimate source of the great Missouri.

Below the junction of the Jefferson, Madison, and Gallatin the course of the Missouri lies through mountain valleys and deep canyons, from which it finally emerges through a gorge in a range of rocks, called by Lewis and Clark the "gates of the Rocky Mountains." Thirty-five miles above Fort Benton the river pours over Great Falls, and from that point onward it is a navigable stream. For miles below the falls the river flows in a deep canyon, with banks ranging from 100 to 160 feet in height. Below the mouth of Marias River, which enters from the north, the banks are less abrupt and rise with gentle slopes to the bluffs. The high-water width of the river, which in the vicinity of Fort Benton is 500 to 1,000 feet, increases to 1,500 feet at the mouth of Milk River and to 2,000 feet near the mouth of the Yellowstone. Below the Yellowstone the width gradually increases from 2,000 to 3,000 feet, and this remains approximately the average width for 600 miles of its course.

From the mouth of the Yellowstone the Missouri follows a winding but on the whole southeasterly course until it is joined by the Kansas; thence it flows more to the east across the State of Missouri, and empties into the Mississippi 16 miles above St. Louis, 189 miles above

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the mouth of the Ohio, and 2,824 miles below the junction of its three upper forks.

For the first 350 miles below the union of the three forks the Missouri is a comparatively clear stream, but approximately midway between the forks and the mouth of the Yellowstone its character gradually changes and it becomes turbid. Although a large amount of the sediment carried by the Missouri is undoubtedly brought in by the drainage of its tributaries, the greater part is derived from the caving of its banks.

Except in the mountain canyons the Missouri flows through an alluvial bottom land of the most fertile character, varying in width from 1½ miles near the mouth to 17 miles in the vicinity of Sioux City.

The volume of Missouri River is subject to great variations, the ordinary high-water discharge at the mouth being about 28 times the low-water discharge. The freshets are caused by melting snows and heavy summer rains. The regular floods occur in May, June, and July, the June discharge being the greatest. Thereafter the river steadily decreases in volume, the minimum being reached during the winter months. Records obtained at Cascade and Townsend indicate 1899 as the wettest year and 1905 as the driest.

The Missouri itself has not been used for irrigation, owing to its high banks and consequent difficulty of diversion. Approximately 150,000 acres of land are now under irrigation in Beaverhead Valley, and by storing the waters of the upper Beaverhead or Red Rock River in Red Rock Lakes fully 125,000 acres more can be put under irrigation.

In Montana the Missouri, with its tributaries, afford many opportunities for power development. A number of large, substantial power stations have been built, and approximately 75,000 horsepower is now being developed. Engineers estimate that 350,000 horsepower can be developed on the Missouri River near Great Falls.

The following gaging stations have been maintained in this river basin:[a]

Red Rock River at Lima, Mont., 1907–8.
Beaverhead River at Barratts, Mont., 1907–8.
Beaverhead River at Dillon, Mont., 1907.
Jefferson River near Sappington, Mont., 1896–1905.
Missouri River near Townsend, Mont., 1895–1904.
Missouri River at Canyon Ferry, Mont., 1889.
Missouri River near Craig, Mont., 1890–1902.
Missouri River at Cascade, Mont., 1902–1908.
Missouri River at Great Falls, Mont., 1897–1905.
Missouri River near Williston, N. Dak., 1905–7.
Missouri River at Mannhaven, N. Dak., 1904.
Missouri River at Washburn, N. Dak., 1905.
Missouri River near Bismarck, N. Dak., 1904–5.
Missouri River at Kansas City, Mo., 1905–6.

[a] Gaging stations in tributary drainage basins are listed under the descriptions of those basins.

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RED ROCK RIVER AT LIMA, MONT.

This station, which was established August 14, 1907, to obtain data concerning the amount of water available for irrigation, is located near Gleed ranch, 1 mile east of Lima.

Red Rock River, here regarded as the headwater stream of the Missouri, rises in Red Rock Lakes in the Rocky Mountains 40 miles east of Lima. The tributaries above the station are small and unimportant, the stream at the gaging station receiving its water supply chiefly from the melting snow in the mountains. Below the station Sheep and Sage creeks are the principal tributaries.

Diversions from this stream are many. Above the station 3 ditches, carrying approximately 900 miner's inches each, receive their water supply from the Red Rock. The water is all appropriated above the station, but the rights are unadjudicated. The dam at the reservoir storing the water of the Red Rock has been completed, but the canals are yet to be built. It is an earthen dam with concrete core, is 50 feet high, and has a capacity of 90,000 acre-feet. The dam is 16 miles above Lima, Mont., and 27 miles below Lower Red Rock lakes. Its top elevation is 6,700 feet. This water will be used to irrigate 25,000 acres of land near Lima.

On October 27, 1908, a new chain gage with a new datum was established 300 feet below the old gage. The stream bed is permanent and the results obtained are good. A large spring enters the stream just above the gage and the river remains open the entire year.

Discharge measurements of Red Rock River at Lima, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 14	Robert Follansbee	37	82	1.90	218
August 27	J. E. Stewart	37	76	1.82	181
October 9	Follansbee and Stewart	37	75	1.80	176
1908.					
April 21	Stewart and Richards	42	156	3.50	694
May 15	Raymond Richards	38	117	2.41	369
June 21	do	41	157	3.38	707
August 13	do	36	65	1.49	124
October 27	do	37	80	1.81	213

31260—IRR 246—10——3

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Daily gage height, in feet, of Red Rock River at Lima, Mont., for 1907.

[J. L. Lewis and E. R. Gleed, observers.]

Day	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1		1.8	1.7	1.8	16	1.9	1.7	1.9	1.7
2		1.8	1.7	1.8	17	1.9	1.7	1.9	1.7
3		1.8	1.8	1.8	18	1.8	1.7	1.9	1.6
4		1.8	1.8	1.8	19	1.5	1.7	1.95	1.8
5		1.6	1.8	1.8	20	1.3	1.7	1.95	1.6
6		1.6	1.8	1.8	21	1.5	1.7	1.95	1.6
7		1.6	1.8	1.8	22	1.4	1.7	1.95	1.7
8		1.7	1.8	1.8	23	1.4	1.7	1.8	1.6
9		1.7	1.8	1.8	24	1.5	1.7	1.8	.....
10		1.7	1.9	1.85	25	1.6	1.7	1.8	.....
11		1.7	1.9	1.8	26	1.8	1.7	1.8	.....
12		1.7	1.9	1.8	27	1.8	1.7	1.8	.....
13		1.7	1.9	1.8	28	1.7	1.7	1.8	.....
14		1.7	1.9	1.8	29	1.7	1.7	1.9	.....
15		1.7	1.9	1.8	30	1.9	1.7	1.8	.....
					31	1.9	.....	1.8	.....

Note. [illegible]

Rating table for Red Rock River at Lima, Mont., for 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
[illegible]							

Note. The above table is not applicable for [illegible] It is based on [illegible]

Monthly discharge of Red Rock [illegible]

Month.	[illegible]	Mean.	Total in acre-feet.	Accuracy.
[illegible]	[illegible]	[illegible]	[illegible]	A.
[illegible]	[illegible]	[illegible]	[illegible]	B.
[illegible]	[illegible]	[illegible]	[illegible]	B.
[illegible]	[illegible]	[illegible]	[illegible]	B.

[illegible] data [illegible] above Bar- [illegible] Red Rock [illegible] junction [illegible] The principal [illegible] grasshopper

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Creek, 12 miles south of Dillon, Horse Prairie Creek, 20 miles south, and Rattlesnake and Blacktail Deer creeks.

Irrigation has probably been practiced in Beaverhead Valley longer than in any other valley in Montana, ditches constructed in the early seventies being still in operation. Innumerable diversions are made. Decreed water rights aggregating 85,866 inches of water are filed on from Lima on Red Rock River to a point 10 miles above Twin Bridges. The three largest canals diverted below the gaging station are Canyon Creek canal, appropriating 6,000 inches; Union canal, appropriating 4,000, and the Beaverhead canal, diverted just north of Dillon, appropriating 5,000 inches. The Union Electric Company, of Dillon, has a canal with a carrying capacity of 6,000 inches.

The stream remains open during the winter months. The gage datum has not been changed. The gaging section has a rocky bottom and should not shift. Records obtained are good.

It is worthy of note that the number and quantity of flow of springs in this valley have increased since irrigation began. The ground evidently serves as a reservoir, the water being absorbed as by a sponge and later coming to the surface as springs.

Discharge measurements of Beaverhead River at Barretts, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
[illegible]	Lawrence Fellenstein	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	J. E. Stewart	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Fellenstein and Stewart	[illegible]	[illegible]	[illegible]	[illegible]
1908.					
[illegible]	Stewart and Richards	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Raymond Richards	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Do	[illegible]	[illegible]	[illegible]	[illegible]

Daily gage height, in feet, of Beaverhead River at Barretts, Mont., for 1907 and 1908.

[Roy E. Dilley, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.					
1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
31		[illegible]		[illegible]			[illegible]	[illegible]		[illegible]		

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Daily gage height, in feet, of Beaverhead River at Barretts, Mont., for 1907 and 1908— Continued.

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												

Monthly discharge of Beaverhead River at Barratts, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
August 12-31	640	389	468	18,600	A.
September	430	322	350	20,800	A.
October	444	342	393	24,200	A.
November	494	404	440	26,200	A.
December	424	296	358	22,000	B.
1908.					
January	350	288	309	19,000	B.
February	300	259	277	15,900	B.
March	524	278	345	21,200	B.
April	909	322	637	37,900	A.
May	2,920	398	805	49,500	A.
June	3,640	1,710	2,610	155,000	A.
July	1,480	550	865	53,200	A.
August	627	487	530	32,600	A.
September	596	432	505	30,000	A.
October	809	568	714	43,900	A.
November	765	468	629	37,400	A.
December	831	412	539	33,100	B.
The year	3,640	270	730	529,000	

BEAVERHEAD RIVER AT DILLON, MONT.

This station, which was established August 28, 1907, is located at the highway bridge on the Bannock Road, three-quarters of a mile from Dillon, Mont. It was discontinued December 31, 1907.

The river at this point flows in two channels. The left channel is the source of supply of a canal which heads a short distance below the bridge, and its flow is controlled by the canal head gates. To determine the total flow of the stream both the right and left channels must be measured. The following gage heights and discharge measurements refer to the right channel only.

Discharge measurements of Beaverhead River at Dillon, Mont., in 1907.

Date.	Hydrographer.	Area of section.	Gage height.	Discharge.
		Sq. ft.	Feet.	Sec.-ft.
August 29	J. E. Stewart	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Estimated because of ice.

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Daily gage height, in feet, of Beaverhead River at Dillon, Mont., for 1907.

Day	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1		3.25	11		3.1	21		3.4
2		3.25	12		3.1	22		3.4
3		3.25	13		3.1	23		3.4
4		3.4	14		3.2	24		3.4
5		3.3	15		3.2	25		3.4
6		3.3	16		3.2	26		3.4
7		3.2	17		3.25	27		3.4
8		3.2	18		3.3	28	3.1	3.4
9		3.2	19		3.4	29	3.05	3.4
10		3.1	20		3.4	30	3.0	3.4
						31	3.2	

MISSOURI RIVER AT CASCADE, MONT.

This station, which was established July 20, 1902, to obtain records for use in connection with irrigation, power development, and for general statistical purposes, is located on the highway bridge on the east side of the town of Cascade, Mont., 100 yards from the Great Northern Railway.

The Missouri receives many tributaries above the station, the most important being Dearborn River, Wolf Creek, and Prickly Pear Creek; within a hundred miles below, Sun and Marias rivers enter. The drainage area at the station is 18,360 square miles.

Although irrigation is extensively developed in the Missouri River Valley, the water supply is obtained from the tributary streams, its [illegible] banks, great variation in flow, and difficulty in diversion causing the Missouri itself to be little used.

The datum of the standard gage chain used at this station has remained unchanged.

Records obtained have been very good, the channel being permanent except in extreme floods. Gage heights are affected by ice during the winter months.

[illegible] Missouri River at Cascade, Mont., in 1907 and 1908.

[illegible]	[illegible]	[illegible]	Gage height.	Discharge.
1907.				Sec.-ft.
[illegible]	[illegible]	[illegible]	[illegible]	6,170
[illegible]	[illegible]	[illegible]	[illegible]	6,560
[illegible]	[illegible]	[illegible]	[illegible]	13,700
[illegible]	[illegible]	[illegible]	[illegible]	25,000
[illegible]	[illegible]	[illegible]	[illegible]	5,000
[illegible]	[illegible]	[illegible]	[illegible]	5,940
1908.				
[illegible]	[illegible]	[illegible]	[illegible]	9,150
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Daily gage height, in feet, of Missouri River at Cascade, Mont., for 1907 and 1908.

[Frank Warner, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1			5.88	5.08	5.70	7.75	10.95	6.90	4.60	4.60	4.70	4.70
2			5.78	5.15	5.50	7.90	10.75	6.80	4.60	4.60	4.80	4.70
3			5.68	5.22	5.50	7.80	10.60	6.05	4.70	4.60	5.00	4.30
4			5.45	5.28	5.62	7.92	10.30	6.40	5.00	4.60	4.90	4.20
5			5.32	5.30	5.75	8.18	10.00	6.35	4.90	4.70	4.50	4.30
6			5.22	5.25	5.30	8.25	10.30	6.25	4.80	5.00	3.90	4.40
7			5.12	5.20	5.42	8.40	10.25	5.10	4.70	5.00	4.85	4.50
8			5.02	5.20	5.65	8.60	10.05	5.35	4.80	5.00	4.85	4.60
9			4.92	5.25	5.42	8.80	9.80	5.60	4.70	5.00	4.50	4.60
10			4.90	5.25	5.42	8.95	9.40	5.80	4.60	5.00	4.10	4.50
11			4.90	5.28	5.55	9.15	9.05	5.80	4.60	4.90	3.80	4.50
12			4.95	5.30	5.65	9.45	8.65	5.80	4.70	4.90	4.00	4.50
13			4.98	5.30	5.50	9.35	7.40	5.50	4.70	4.80	4.70	4.50
14			5.00	5.30	5.98	9.15	7.65	5.70	4.70	4.70	5.20	4.50
15			5.08	5.60	6.40	9.30	7.95	5.50	4.80	4.70	4.90	4.50
16			5.10	6.05	6.58	9.15	8.05	5.50	4.70	4.70	4.50	4.50
17			5.18	6.10	6.55	9.00	8.35	5.50	4.70	4.70	4.60	4.60
18			5.22	6.32	6.60	8.90	8.55	4.95	4.70	4.70	3.80	4.80
19			5.32	6.30	6.60	8.75	8.60	4.75	4.60	4.70	4.30	.....
20			5.42	6.56	6.80	8.45	8.60	4.10	4.65	4.75	5.00	.....
21			5.55	6.40	7.20	8.15	8.80	4.10	4.70	5.20	4.80	.....
22		6.25	5.68	6.25	7.85	7.90	8.50	4.50	4.60	5.70	4.50	.....
23		6.50	5.70	6.05	8.05	11.25	7.60	4.20	4.60	5.60	4.10	.....
24		6.38	5.56	6.05	8.22	12.55	7.95	4.20	4.60	4.85	4.10	.....
25		6.28	5.46	6.00	8.35	11.85	7.30	4.20	4.60	4.65	4.00	.....
26		6.18	5.36	5.95	8.35	11.90	6.65	4.20	4.60	4.10	4.70	.....
27		6.08	5.28	5.85	8.10	11.65	7.10	4.20	4.60	3.80	5.00	.....
28		5.98	5.18	5.85	7.90	11.65	7.20	4.25	4.60	4.25	4.70	.....
29			5.15	5.80	7.80	11.70	7.30	4.25	4.60	4.45	4.20	.....
30			5.05	5.78	7.75	11.45	7.10	4.75	4.60	4.60	4.30	.....
31			5.05	.....	7.50	.....	7.00	4.70	....	4.60	....	.....
1908.												
1	5.95	6.30	4.60	4.50	5.30	10.45	10.10	5.25	4.70	5.05	5.70	5.05
2	5.90	6.30	4.50	4.60	5.20	11.30	9.65	4.95	4.70	5.25	5.75	6.15
3	5.90	6.00	4.60	4.70	5.20	11.75	9.30	4.80	4.70	5.20	5.90	6.00
4	5.90	5.90	4.90	4.80	5.80	11.15	9.30	4.80	4.70	5.20	5.90	6.00
5	5.70	5.35	4.80	4.80	5.60	11.45	9.30	4.95	4.70	5.20	5.60	6.20
6	5.95	5.30	4.50	4.60	5.60	11.60	9.30	5.15	4.70	5.20	5.60	7.05
7	6.30	5.10	4.70	4.75	5.70	11.40	9.10	4.80	4.70	5.20	5.60	7.00
8	6.30	5.10	4.70	4.70	5.90	11.20	8.90	4.80	4.70	5.20	5.60	7.20
9	6.30	5.10	4.70	4.70	5.90	11.00	8.70	4.80	4.70	5.20	5.60	7.20
10	6.30	5.10	4.80	4.70	5.80	10.80	8.50	4.80	4.70	5.20	5.60	7.20
11	6.30	5.30	4.70	4.60	5.80	10.60	7.90	4.80	4.70	5.20	5.60	7.20
12	6.30	5.30	4.60	4.60	5.80	10.40	7.70	4.80	4.70	5.20	5.60	7.20
13	6.30	5.40	4.70	4.60	5.80	10.20	7.50	4.80	4.70	5.20	5.60	6.90
14	6.30	5.40	4.70	4.60	5.80	10.00	7.30	4.80	4.70	5.20	5.60	6.70
15	6.30	5.40	4.65	4.60	5.80	9.80	7.10	4.80	4.70	5.20	5.60	6.50
16	6.30	5.40	4.60	4.60	5.80	9.60	6.90	4.80	4.70	5.20	5.60	6.30
17	6.30	5.40	4.60	4.60	5.80	9.40	6.70	4.80	4.70	5.20	5.60	6.10
18	6.30	5.40	4.60	4.60	5.80	9.20	6.50	4.80	4.70	5.20	5.60	5.90
19	6.30	5.40	4.60	4.60	5.80	9.00	6.30	4.80	4.70	5.20	5.60	5.70
20	6.30	5.40	4.60	4.60	5.80	8.80	6.10	4.80	4.70	5.20	5.60	5.50
21	6.30	5.40	4.60	4.60	5.80	8.60	5.90	4.80	4.70	5.20	5.60	5.30
22	6.30	5.40	4.60	4.60	5.80	8.40	5.70	4.80	4.70	5.20	5.60	5.10
23	6.30	5.40	4.60	4.60	5.80	8.20	5.50	4.80	4.70	5.20	5.60	4.90
24	6.30	5.40	4.60	4.60	5.80	8.00	5.30	4.80	4.70	5.20	5.60	4.70
25	6.30	5.40	4.60	4.60	5.80	7.80	5.10	4.80	4.70	5.20	5.60	4.50
26	6.30	5.40	4.60	4.60	5.80	7.60	4.90	4.80	4.70	5.20	5.60	4.30
27	6.30	5.40	4.60	4.60	5.80	7.40	4.70	4.80	4.70	5.20	5.60	4.10
28	6.30	5.40	4.60	4.60	5.80	7.20	4.50	4.80	4.70	5.20	5.60	3.90
29	6.30	5.40	4.60	4.60	5.80	7.00	4.30	4.80	4.70	5.20	5.60	3.70
30	6.30	5.40	4.60	4.60	5.80	6.80	4.10	4.80	4.70	5.20	5.60	3.50
31	6.30	.....	4.60	.....	5.80	.....	3.90	4.80	.....	5.20	.....	3.30

[illegible]

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Rating tables for Missouri River at Cascade, Mont.

JANUARY 1, 1907, TO APRIL 15, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	1,900	4.90	4,930	6.30	9,400	8.40	17,640
3.60	2,040	5.00	5,210	6.40	9,750	8.60	18,480
3.70	2,190	5.10	5,500	6.50	10,110	8.80	19,330
3.80	2,350	5.20	5,800	6.60	10,470	9.00	20,170
3.90	2,520	5.30	6,100	6.70	10,840	9.20	21,030
4.00	2,700	5.40	6,410	6.80	11,210	9.40	21,890
4.10	2,910	5.50	6,720	6.90	11,580	9.60	22,750
4.20	3,130	5.60	7,040	7.00	11,970	9.80	23,620
4.30	3,360	5.70	7,360	7.20	12,730	10.00	24,500
4.40	3,600	5.80	7,690	7.40	13,500	11.00	28,950
4.50	3,850	5.90	8,020	7.60	14,300	12.00	33,450
4.60	4,110	6.00	8,360	7.80	15,120		
4.70	4,390	6.10	8,700	8.00	15,960		
4.80	4,650	6.20	9,050	8.20	16,800		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907 and is well defined between gage heights 4.0 feet and 10.0 feet.

APRIL 16 TO DECEMBER 31, 1908.

3.30	1,310	4.90	4,220	6.50	9,220	9.20	20,500
3.40	1,400	5.00	4,500	6.60	9,580	9.40	21,400
3.50	1,500	5.10	4,770	6.70	9,950	9.60	22,300
3.60	1,610	5.20	5,050	6.80	10,330	9.80	23,200
3.70	1,740	5.30	5,340	6.90	10,710	10.00	24,100
3.80	1,880	5.40	5,630	7.00	11,100	10.20	25,000
3.90	2,040	5.50	5,930	7.20	11,890	10.40	25,900
4.00	2,210	5.60	6,230	7.40	12,700	10.60	26,800
4.10	2,390	5.70	6,530	7.60	13,530	10.80	27,700
4.20	2,580	5.80	6,850	7.80	14,360	11.00	28,600
4.30	2,780	5.90	7,170	8.00	15,200	12.00	33,100
4.40	3,000	6.00	7,500	8.20	16,060	13.00	37,600
4.50	3,230	6.10	7,830	8.40	16,930	14.00	42,100
4.60	3,470	6.20	8,170	8.60	17,810	15.00	46,600
4.70	3,720	6.30	8,510	8.80	18,700	16.00	51,100
4.80	3,970	6.40	8,860	9.00	19,600		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1908 and high-water measurements of previous years, and is fairly well defined above gage height 4.5 feet. Below 4.5 feet the rating is somewhat uncertain. Above gage height 9.0 feet the curve is a tangent, the difference being 450 per tenth.

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Monthly discharge of Missouri River at Cascade, Mont., for 1907 and 1908.

[Drainage area, 18,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March	7,950	4,990	6,040	0.330	0.38	371,000	A.
April	10,400	5,440	7,320	.400	.45	436,000	A.
May	17,400	6,100	10,700	.585	.67	658,000	A.
June	36,000	14,900	22,200	1.21	1.35	1,320,000	A.
July	28,700	10,800	18,700	1.02	1.18	1,150,000	A.
August	11,600	2,910	6,010	.328	.38	370,000	A.
September	5,210	4,110	4,320	.236	.26	257,000	A.
October	7,360	2,350	4,580	.250	.29	282,000	A.
November	5,800	2,350	3,910	.214	.24	233,000	A.
December	.....	.....	a 3,500	.191	.22	215,000	A.
The period	.....	.....	.....	.....	.....	5,290,000	
1908.							
April	31,100	3,240	6,530	.357	.40	389,000	A.
May	19,800	5,630	9,090	.497	.57	559,000	A.
June	49,300	25,200	36,700	2.01	2.24	2,180,000	A.
July	24,600	5,480	12,800	.699	.81	787,000	A.
August	5,200	2,780	3,810	.208	.24	234,000	A.
September	5,340	3,230	4,050	.221	.25	241,000	A.
October	8,170	4,640	6,320	.345	.40	389,000	A.
November	6,530	5,060	5,850	.320	.36	348,000	A.
The period	.....	.....	.....	.....	.....	5,130,000	

a Estimated.

MISSOURI RIVER NEAR WILLISTON, N. DAK.

This station, which is located at Bakers Ferry, 10 miles down the river from Williston, N. Dak., and 13½ miles southeast by the main traveled road on the east side of the river from Williston ferry landing, was established April 24, 1905, for the purpose of obtaining general information concerning run-off. It was discontinued May 23, 1907.

Yellowstone River, which enters the Missouri about 20 miles above the station, is the nearest important tributary. The drainage area above this point includes the entire basin of the Missouri in Montana and northern Wyoming.

Discharge measurements of Missouri River near Williston, N. Dak., in 1905 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		Feet.	Sq. ft.	Feet.	Sec.-ft.
April 24	E. F. Chandler	525	4,490	5.20	10,400
May 22	Chandler and Richards	505	4,540	6.50	12,600
June 21	P. M. Churchill	757	13,300	12.20	69,900
July 16	do	770	11,700	11.10	58,600
August 14	do	753	5,950	6.75	14,900
September 19	Chandler and Fellows	435	2,700	4.41	6,780
1908.					
June 20	E. F. Chandler	965	a 19,900	19.40	147,000

a Approximate.

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Daily gage height, in feet, of Missouri River near Williston, N. Dak., for 1907.

[G. E. Baker, observer.]

Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.	Day.	Mar.	Apr.	May.
1	14.0	14.7	10.4	11	11.2	11.7	9.9	21	11.3	10.9	11.3
2	13.9	14.8	10.3	12	11.2	12.2	10.0	22	11.5	10.8	11.4
3	13.5	15.4	10.2	13	11.25	11.7	10.1	23	12.9	10.75	.....
4	13.1	15.9	10.0	14	11.25	11.5	10.0	24	14.4	10.7	.....
5	12.9	15.9	10.0	15	11.3	11.6	10.3	25	16.0	10.9	.....
6	12.6	12.5	10.1	16	11.3	11.6	10.8	26	17.3	11.0	.....
7	12.3	13.1	10.0	17	11.1	11.4	11.0	27	16.8	11.0	.....
8	12.0	12.2	9.9	18	10.9	11.2	11.0	28	16.5	10.9	.....
9	11.9	12.0	9.8	19	11.0	11.1	11.1	29	16.4	10.6	.....
10	11.4	11.8	9.8	20	11.1	11.0	11.2	30	16.0	10.4	.....
								31	15.2	.....	.....

Rating table for Missouri River near Williston, N. Dak., for 1905–1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	6,000	5.50	9,500	7.00	16,900	9.80	43,900
4.10	6,200	5.60	9,830	7.20	18,480	10.00	46,000
4.20	6,400	5.70	10,170	7.40	20,080	11.00	56,500
4.30	6,600	5.80	10,540	7.60	21,750	12.00	67,000
4.40	6,800	5.90	10,910	7.80	23,520	13.00	77,500
4.50	7,000	6.00	11,300	8.00	25,400	14.00	88,000
4.60	7,220	6.10	11,700	8.20	27,400	15.00	99,000
4.70	7,440	6.20	12,150	8.40	29,400	16.00	110,000
4.80	7,660	6.30	12,620	8.60	31,420	17.00	121,000
4.90	7,880	6.40	13,120	8.80	33,460	18.00	132,000
5.00	8,100	6.50	13,650	9.00	35,500	19.00	143,000
5.10	8,340	6.60	14,200	9.20	37,600	20.00	154,000
5.20	8,600	6.70	14,800	9.40	39,700	21.00	165,000
5.30	8,880	6.80	15,450	9.60	41,800	22.00	176,000
5.40	9,180	6.90	16,150				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1905 and one flood measurement made June 20, 1908, and is not well defined. Above gage height 14.0 feet the rating curve is a tangent, the difference being 1,100 per tenth.

Monthly discharge of Missouri River near Williston, N. Dak., for 1905–1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
May 23–31	40,800	14,800	30,200	539,000	C.
June	83,800	38,600	68,100	4,050,000	C.
July	73,300	34,500	54,900	3,380,000	C.
August	43,900	7,880	19,400	1,190,000	C.
September	7,880	6,000	7,100	422,000	C.
October	9,830	6,400	7,700	473,000	D.
November	8,600	7,220	8,060	480,000	D.
The period				10,500,000	
1906.					
May 26–31	90,200	73,300	82,800	985,000	C.
June	155,000	61,800	93,600	5,570,000	C.
July	74,400	36,600	52,700	3,240,000	C.
August	45,000	13,100	25,200	1,550,000	C.
September	25,400	10,500	15,400	916,000	D.
October	10,200	8,340	8,840	544,000	D.
November 1–24	23,500	8,600	10,100	481,000	D.
The period				13,300,000	
1907.					
[illegible]arch	124,000	55,400	77,900	4,790,000	C.
[illegible]il	109,000	50,200	67,500	4,020,000	C.
[illegible] 1–22	60,700	43,900	50,100	2,190,000	C.

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PRICKLY PEAR CREEK DRAINAGE BASIN.

DESCRIPTION.

Prickly Pear Creek rises in the mountains in the northwestern part of Jefferson County, Mont., and takes a general northeasterly course to its junction with the Missouri near Eldorado bar in the southeastern part of Lewis and Clark County. Its principal tributaries are McClellan, Lump Gulch, Tenmile, and Silver creeks. Its upper valley is narrow and little irrigation is practiced, but below Helena the entire normal flow is diverted for irrigation.

The following gaging stations have been maintained in this basin:

Prickly Pear Creek near Clancy, Mont., 1908.
Prickly Pear Creek at East Helena, Mont., 1908.
Lump Gulch Creek near Clancy, Mont., 1908.
Tenmile Creek near Helena, Mont., 1908.
Sevenmile Creek near Helena, Mont., 1908.

PRICKLY PEAR CREEK NEAR CLANCY, MONT.

This station, which was established July 15, 1908, to obtain data for use in connection with irrigation projects, is located about 2 miles below Clancy and 12 miles south of Helena, and is directly west of the house of the observer.

Lump Gulch Creek enters about a mile above the station, and McClellan Creek comes in between the station and East Helena. Owing to the very narrow valley and the small amount of irrigable land above the station, little water is diverted for irrigation.

The stream bed is of gravel and sand and shifts. Gage heights are affected by ice during the winter months and the records obtained are unsatisfactory.

The greatest flood experienced in this valley for many years is probably that of June, 1908.

Discharge measurements of Prickly Pear Creek near Clancy, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 15	J. E. Stewart	30	45.2	1.86	96.8
August 10	Raymond Richards	26	21.6	.89	[a] 40.1
October 10	....do	32	42.5	1.79	79.9

[a] Meter in poor condition; discharge considered small.

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Daily gage height, in feet, of Prickly Pear Creek near Clancy, Mont., for 1908.

[John Gillis, observer.]

Day	July	Aug.	Sept.	Oct.	Nov.	Dec.
1					1.0	1.4
2					1.0	1.4
3					1.0	1.4
4					1.9	1.4
5					1.9	1.2
6					1.9	1.2
7					1.5	1.2
8					1.9	1.2
9					1.9	1.0
10				1.8	1.7	1.0
11				1.8	1.7	1.9
12				1.8	1.7	1.9
13				1.8	1.5	1.3
14				1.8	1.5	1.2
15				1.6	2.4	1.3

Day	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.85			1.6	2.0	1.2
17	1.8			1.6	2.4	1.2
18	1.7			1.4	1.9	1.2
19	1.65			1.4	1.9	1.0
20	1.55			1.9	1.7	1.5
21	1.5			1.9	1.7	1.5
22	1.4			1.9	1.8	1.5
23	1.6			1.4	1.8	1.2
24	1.5			1.4	1.8	1.2
25	1.4			2.0	1.8	1.2
26				2.0	1.6	1.0
27				2.0	1.6	1.9
28				1.7	1.6	1.9
29				1.7	1.2	1.8
30				1.7	1.2	1.7
31				1.6		1.6

PRICKLY PEAR CREEK AT EAST HELENA, MONT.

This station, which was established July 18, 1908, to obtain data for use in irrigation development, is located where the Northern Pacific Railway crosses the stream at East Helena, Mont.

McClellan and Lump Gulch creeks are the only important tributaries entering above the station; Tenmile and Silver creeks come in below. All the normal flow of this stream is used for irrigation, the greater part of the water being diverted below this station.

At the gaging section the channel is rocky, clean, and nonshifting. The bed of the stream is so extremely rough that even in low water measurements are difficult. Fair results, however, have been obtained.

Discharge measurements of Prickly Pear Creek at East Helena, Mont., in 1908.

Date.	Area of section.	Gage height.	Discharge.
	Sq. ft.	Feet.	Sec.-ft.
	[illegible]	1.49	104
	[illegible]	1.19	a51.9
	[illegible]	1.39	101

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Daily gage height, in feet, of Prickly Pear Creek at East Helena, Mont., for 1908.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.1	1.1	1.1	1.3	1.2	16	.....	1.2	1.1	1.6	1.0	.....
2	.....	1.1	1.1	1.2	1.3	1.2	17	.....	1.1	1.1	1.6	1.2	.....
3	.....	1.1	1.1	1.4	1.3	1.1	18	.....	1.1	1.1	1.4	1.3	.....
4	.....	1.1	1.1	1.4	1.3	1.0	19	1.4	1.1	1.1	1.4	1.2	.....
5	.....	1.1	1.1	1.4	1.3	1.0	20	1.4	1.2	1.1	1.4	1.2	.....
6	.....	1.1	1.1	1.4	1.3	.....	21	1.4	1.1	1.1	1.4	1.2	.....
7	.....	1.1	1.1	1.4	1.3	.....	22	1.4	1.1	1.2	1.3	1.2	.....
8	.....	1.1	1.1	1.4	1.3	.....	23	1.4	1.1	1.1	1.3	1.2	.....
9	.....	1.1	1.1	1.4	1.3	.....	24	1.5	1.0	1.1	1.3	1.1	.....
10	.....	1.1	1.1	1.4	1.3	.....	25	1.3	.9	1.0	1.3	1.1	.....
11	.....	1.1	1.1	1.4	1.1	.....	26	1.3	1.0	1.0	1.3	1.1	.....
12	.....	1.1	1.1	1.4	1.0	.....	27	1.3	1.1	1.0	1.3	1.2	.....
13	.....	1.2	1.1	1.4	.9	.....	28	1.2	1.1	1.0	1.3	1.2	.....
14	.....	1.4	1.1	1.4	1.0	.....	29	1.2	1.1	1.0	1.3	1.1	.....
15	.....	1.2	1.1	1.4	1.0	.....	30	1.2	1.1	1.1	1.3	1.1	.....
							31	1.1	1.1	.....	1.3	.....	.....

LUMP GULCH CREEK NEAR CLANCY, MONT.

Lump Gulch Creek, a small mountain stream with no important tributaries, has been quite extensively used for placer mining, and many diversions were made for that purpose. At present some irrigation is practiced, but the valley is narrow and affords but little irrigable land. The normal flow of the stream is appropriated.

The gaging station, which was established July 15, 1908, to obtain information concerning the amount of water available for storage and for irrigation, is located at the ranch of Charles Zastrow, 1 mile from Clancy, 15 miles from Helena, and one-half mile above the stream's junction with Prickly Pear Creek.

The stream bed is gravelly, unclean, and shifting, making it difficult to obtain satisfactory data. Gage heights are affected by ice. No flood records have been obtained.

Discharge measurements of Lump Gulch Creek at Clancy, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 15	J. E. Stewart	10.7	12.6	1.30	21.0
August 10	Raymond Richards	6.0	2.9	.75	3.9
October 10	....do	12.5	9.2	1.22	17.2

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Daily gage height, in feet, of Lump Gulch Creek at Clancy, Mont., for 1908.

[Charles Zastrow, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1		0.95	0.85	0.95	1.1	16	1.3	0.85	0.85	1.10	1.05
2		.95	.85	1.06	1.1	17	1.3	.8	.95	1.10	1.1
3		.9	.85	1.01	1.1	18	1.25	.8	.95	1.10	1.1
4		.85	.8	1.01	1.05	19	1.15	.8	.95	1.10	1.1
5		.8	.8	1.02	1.05	20	1.15	.85	1.0	1.10	1.1
6		.8	.75	1.02	1.05	21	1.15	.85	1.0	1.10	1.1
7		.8	.75	1.02	1.05	22	1.1	.85	1.0	1.10	1.05
9		.75	.8	1.02	1.05	23	1.1	.9	1.0	1.10	1.05
9		.75	.8	1.02	1.05	24	1.15	.85	1.0	1.10	1.05
10		.75	.8	1.25	1.05	25	1.15	.85	1.0	1.10	1.05
11		.7	.8	1.15	1.05	26	1.15	.85	1.0	1.10	1.05
12		.7	.8	1.15	1.05	27	1.15	.85	1.0	1.10	1.05
13		.95	.8	1.15	1.05	28	1.1	85	1.0	1.10	1.05
14		.9	.85	1.15	1.05	29	1.1	.85	.95	1.10	1.05
15	1.35	.85	.85	1.10	1.05	30	1.05	.85	.95	1.10	1.05
						31	1.0	.85		1.10	

TENMILE CREEK NEAR HELENA, MONT.

This station, which is located opposite the Broadwater Hotel, near Helena, Mont., was established July 8, 1908, to determine the amount of water available for irrigation and for municipal supply.

Part of the water supply of the city of Helena is taken from Tenmile Creek above the station. Two irrigation ditches also take their water from this creek above the gage. The entire low-water flow is appropriated and used before it reaches the mouth of the creek.

The principal tributaries above the gaging station are Blue Cloud, Spring, and Walker creeks; Sevenmile Creek enters 2 miles below.

The channel shifts somewhat during flood stages, but at medium and low water the conditions are good for obtaining accurate discharge data. The stream freezes over during the winter months and no records are kept.

Discharge measurements of Tenmile Creek near Helena, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 8	J. E. Stewart	20	26.7	2.19	22.6
July 16	do	20	20.3	1.93	11.6
August 11	Raymond Richards			1.25	*e*.5
October 26	do	34	25.4	2.49	31.8

e Estimated.

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Daily gage height, in feet, of Tenmile Creek near Helena, Mont., for 1908.

[Harry Hillman, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.5	1.3	2.0	2.5	16	1.9	1.4	1.4	2.85	2.85
2	.....	1.45	1.3	2.2	2.5	17	2.0	1.45	1.65	2.7	2.4
3	.....	1.4	1.25	2.55	2.5	18	2.0	1.45	1.95	2.6	2.4
4	.....	1.35	1.25	2.15	2.5	19	1.9	1.4	2.0	2.6	2.3
5	.....	1.35	1.25	2.3	2.45	20	1.9	1.9	1.85	2.6	2.3
6	.....	1.3	1.2	2.25	2.45	21	1.85	1.4	1.8	2.6	2.3
7	.....	1.25	1.35	2.3	2.45	22	1.85	1.4	1.75	2.5	2.3
8	2.2	1.25	1.5	2.4	2.45	23	1.9	1.35	1.75	2.5	2.3
9	2.15	1.25	1.6	2.4	2.35	24	1.8	1.35	1.8	2.5	2.2
10	2.1	1.25	1.4	2.45	2.3	25	1.75	1.35	1.8	2.5	2.25
11	2.1	1.25	1.4	2.6	2.25	26	1.75	1.3	1.8	2.5	2.25
12	2.05	1.25	1.3	2.75	2.25	27	1.7	1.3	1.8	2.5	2.2
13	2.05	1.3	1.3	2.8	2.3	28	1.65	1.3	1.85	2.5	2.15
14	2.0	1.65	1.3	2.9	2.5	29	1.6	1.3	1.9	2.5	2.2
15	1.9	1.55	1.3	3.0	2.55	30	1.5	1.3	1.95	2.5	2.0
						31	1.5	1.35	.....	2.5	...

Rating table for Tenmile Creek near Helena, Mont., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	0.	1.60	4.0	2.10	19.0	2.60	59
1.20	.5	1.70	6.0	2.20	25	2.70	70
1.30	1.0	1.80	8.5	2.30	32	2.80	82
1.40	1.5	1.90	11.5	2.40	40	2.90	95
1.50	2.5	2.00	15.0	2.50	49	3.00	109

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1908–9 and is well defined.

Monthly discharge of Tenmile Creek near Helena, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 8–31	25	2.5	11.8	592	A.
August	11.5	.8	1.76	108	C.
September	15.0	.5	5.20	309	B.
October	109	15.0	52.8	3,250	A.
November	54	15.0	36.4	2,170	A.

SEVENMILE CREEK NEAR HELENA, MONT.

This station, which is located at Doctor Head's ranch, near Helena, Mont., was established July 16, 1908, and discontinued August 26 of the same year. The records determine the value of the stream for irrigation and municipal water supply.

The entire flow of this creek is appropriated and used for irrigation.

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Discharge measurements of Sevenmile Creek near Helena, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 16.	J. K. Stewart	9.5	7.2	1.42	12.0
August 11	Raymond Richards	6.0	1.9	.89	2.8

Daily gage height, in feet, of Sevenmile Creek near Helena, Mont., for 1908.

Day.	July.	Aug.	Day.	July.	Aug.	Day.	July.	Aug.
1	....	1.10	11	.....	1.10	21	1.40	2.00
2	.	1.10	12	.....	1.32	22	1.40	2.00
3	.	1.10	13	.....	1.40	23	1.30	2.00
4	.	1.10	14	.....	1.40	24	1.32	2.00
5	. .	1.10	15	.....	1.40	25	1.32	2.00
6	.	1.10	16	1.42	1.40	26	1.30	2.00
7	..	1.10	17	1.42	1.80	27	1.30	.....
8	.	1.10	18	1.42	1.80	28	1.30	.....
9	.	1.10	19	1.40	2.00	29	1.35	.....
10	..	1.10	20	1.40	2.00	30	1.30	.....
						31	1.30	.....

DEARBORN RIVER DRAINAGE BASIN.

DESCRIPTION.

Dearborn River rises on the eastern slope of the Rocky Mountains in Lewis and Clark County, Mont., and takes a general southeasterly course to its junction with the Missouri about 40 miles southwest of Great Falls.

The construction of a project under the Carey Act to reclaim about 30,000 acres of land was undertaken several years ago. The water supply for this project comes from the natural flow of the Dearborn at a point just below the mouth of Falls Creek.

The following gaging stations have been maintained in this drainage basin:

Dearborn River near Clemons, Mont. (p. 49).
Sevenmile Creek near Clemons, Mont. (p. 48).

DEARBORN RIVER NEAR CLEMONS, MONT.

This station, which was established [illegible] to obtain information concerning the amount of water available for irrigation, is located 2 miles above Clemons, Mont., and [illegible] above the headworks of the reclamation project.

The only important tributary [illegible] Falls Creek, which enters one-half mile below. The drainage area is [illegible] square miles.

Measurements of discharge are made [illegible]. The conditions during accurate [illegible] medium stages, [illegible] flood stages are [illegible]. The stream freezes [illegible], and no record [illegible] is kept. The [illegible] station.

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Discharge measurements of Dearborn River near Clemons, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Stewart & Richards	35	48.8	0.60	104
July 13	Raymond Richards	68	72.9	.43	156
August 29	do	59	40.6	— .03	55.6
October 16	do	61	86	.61	217

NOTE.—Measurements made by wading.

Daily gage height, in feet, of Dearborn River near Clemons, Mont., for 1908.

[A. F. Kenck and O. A. Kenck, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1				0.17			0.15
2			0.68		−0.20	0.00	
3				.13		— .04	.15
4	0.60		.68		— .22		
5	.65			.10		— .03	.13
6	.80		.55		— .22		
7	.85			.10		.12	.13
8			.50		— .25		
9	.88			.08		.22	.11
10					— .25	.30	
11	1.03		.48	.10			.12
12		1.93	.45		— .27	.87	
13	.98		.42	.18			.12
14		1.40			— .27	.88	
15	1.15		.42	.14			.12
16		1.37			— .20	.61	
17	1.10		.40	.00	— .10		.12
18		1.10			.00	.42	
19	1.12		.23	.02			.11
20		1.00			— .06	.28	
21	1.10		.18	.00			.11
22		.85			— .06	.27	
23	1.01		.20	.00			.11
24	1.10	.82	.20		— .06	.21	
25				— .07			.09
26	1.88	.89	.18		— .05	.20	
27				— .05			.09
28	1.40	.78	.18		— .08	.15	
29				— .02			.05
30	1.60	.70	.18		— .05	.15	.06
31				— .20			

NOTE.—From June 1–11 observer was unable to get to the gage on account of high water.

FALLS CREEK NEAR CLEMONS, MONT.

This station, which is located 1½ miles above Clemons, Mont., and 500 feet above the mouth of the creek, was established May 4, 1908, to obtain data for use in connection with water-power and irrigation development.

Falls Creek has a large fall above the gaging station and affords opportunities for water-power development. No water is diverted from this stream, its entire flow reaching Dearborn River.

The conditions for obtaining accurate discharge measurements are fair at medium and low stages. Measurements are impossible at

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flood stages, as they can be made only by wading. No records are kept during the winter, as the gage heights are affected by ice. The datum of the gage has remained unchanged.

Discharge measurements of Falls Creek near Clemons, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Stewart and Richards	25	22.8	1.31	29.7
July 13	Raymond Richards	35	34.4	1.37	79.7
August 29	do	28	18.4	1.01	30.5
October 16	do	32	34.2	1.43	78.7

NOTE.—Measurements made by wading.

Daily gage height, in feet, of Falls Creek near Clemons, Mont., for 1908.

[A. F. Kenck and O. A. Kenck, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	.....	1.18	.....	.....	1.15	16	.....	.....	.....	.....	0.96	1.43	.....
2	.....	.....	.....	.....	0.97	1.40	.....	17	1.80	.....	1.30	1.15	1.00	.....	1.10
3	.....	.....	.....	1.12	.....	1.16	1.13	18	.....	.....	.....	.....	1.05	1.32	.....
4	1.31	.....	.....	.....	.95	.....	.....	19	1.85	.....	1.28	1.11	.....	.....	1.09
5	1.32	.....	.....	1.10	.....	1.05	1.13	20	.....	.....	.....	.....	.95	1.30	.....
6	1.35	.....	.....	.....	.96	.....	.....	21	.....	.....	1.25	1.05	.....	.....	1.10
7	1.42	.....	.....	1.10	.....	1.05	1.13	22	.....	.....	.....	.....	.95	1.24	.....
8	.....	.....	.....	.....	.95	.....	.....	23	.....	.....	1.24	1.05	.....	.....	1.09
9	1.53	.....	.....	1.10	.....	1.09	1.12	24	.....	.....	1.20	.....	.95	1.20	.....
10	.....	.....	.....	.....	.95	1.12	.....	25	.....	.....	.....	1.01	.....	.....	1.07
11	1.65	.....	.....	1.11	.....	.....	1.10	26	.....	.....	1.18	.....	.97	1.18	.....
12	.....	.....	.....	.....	.93	1.25	.....	27	.....	.....	.....	1.00	.....	.....	1.07
13	1.68	.....	1.37	1.19	.....	.....	1.10	28	.....	.....	1.15	.....	.98	1.18	.....
14	.....	.....	.....	.....	.92	1.40	.....	29	.....	.....	.....	1.00	.....	.....	1.03
15	1.79	.....	1.34	1.17	.....	.....	1.10	30	.....	.....	1.18	.....	.96	1.15	1.03
								31	.....	.....	.....	.96	.....	.....	.....

NOTE.—Gage washed out by flood May 21, 1908.

SMITH RIVER DRAINAGE BASIN.

SMITH RIVER AT TRULY, MONT.

Smith River rises in the Crazy Mountains in southern Meagher County, Mont., flows northwestward, and enters the Missouri about 15 miles southwest of Great Falls.

Only one gaging station has been maintained in this basin. This station, which was established March 7, 1905, and was discontinued June 30, 1907, was located at a steel highway bridge on the county road running up Smith River valley, near the discontinued post-office of Truly and about 20 miles southwest of Great Falls. The [illegible] are valuable in connection with irrigation development in Smith [illegible] valley.

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Discharge measurements of Smith River at Truly, Mont., in 1905–1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		Feet.	Sq. ft.	Feet.	Sec.-ft.
March 7	Porter and Hirt	57	179	1.50	193
March 15	Stevenson and Porter	51	201	1.72	155
Sept. 1	A. P. Porter	.....	69	1.20	33.9
1906.					
April 9	Warren and Edson	80	194	2.17	430
May 3	Gardner Edson	80	132	1.61	307
July 12	Raymond Richards	80	103	1.31	91.1
November 28	do	62	30	1.00	78.9
1907.					
April 22	J. E. Stewart	96	134	2.59	359

a Made by wading.

Daily gage height, in feet, of Smith River at Truly, Mont., for 1907.

[Henry V. Evans and David H. Evans, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	1.68	2.20	1.75	1.95	2.30	3.95	16	.....	2.75	1.80	2.65	3.60	3.70
2	1.75	.....	1.80	2.50	2.30	4.00	17	.....	2.75	1.75	2.90	3.85	3.40
3	1.60	.....	1.80	2.85	2.25	4.10	18	2.20	2.58	1.80	2.50	3.75	3.35
4	1.48	.....	1.70	3.10	2.20	4.10	19	.....	2.05	2.15	2.40	3.30	3.20
5	1.65	2.30	1.82	3.25	2.20	4.00	20	.....	2.35	2.08	2.40	4.35	3.15
6	.....	3.92	1.85	3.00	2.20	3.95	21	.....	2.75	3.40	2.30	4.80	3.35
7	.....	3.82	1.80	2.95	2.12	4.05	22	2.20	3.00	3.00	2.30	4.45	3.45
8	1.80	4.05	1.80	2.65	2.30	4.00	23	.....	3.45	4.10	2.35	4.05	5.05
9	.....	3.70	1.85	2.55	2.45	4.00	24	.....	2.52	3.05	2.40	4.55	9.00
10	.....	2.90	1.88	2.55	2.55	3.85	25	2.20	2.25	3.05	2.35	4.40	8.05
11	.....	2.70	1.78	2.70	2.65	3.85	26	.....	2.15	2.65	2.30	4.10	6.90
12	.....	2.85	1.75	2.95	2.75	3.85	27	.....	1.95	1.92	2.25	3.80	5.75
13	.....	2.75	1.80	2.75	2.75	3.75	28	.....	1.75	1.82	2.25	3.65	5.45
14	.....	2.75	1.78	2.65	2.65	3.95	29	2.20		1.85	2.20	3.60	5.15
15	2.10	2.95	1.70	2.60	2.60	3.80	30	.....	...	1.82	2.30	3.60	4.80
							31	.....	...	1.80		3.75	...

NOTE.—River frozen Jan. 1–Feb. 14, 1907.

Rating table for Smith River at Truly, Mont., for 1905–1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.00	10	1.60	111	2.20	321	2.80	699
1.10	20	1.70	140	2.30	366	2.90	660
1.20	32	1.80	173	2.40	412	3.00	712
1.30	47	1.90	207	2.50	461	3.10	765
1.40	65	2.00	242	2.60	508	3.20	819
1.50	86	2.10	280	2.70	559		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made in 1905–1907, and is fairly well defined between gage heights 1.0 foot and 2.70 feet. Above gage height 3.2 feet the rating curve is a tangent, the difference being 50 feet per foot.

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Monthly discharge of Smith River at Truly, Mont., for 1905–1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
March 7–31	173	76	135	6,080	A.
April	140	86	109	6,490	B.
May	234	86	149	9,160	A.
June	534	280	336	20,000	B.
July	309	86	154	9,470	A.
August	173	49	74.6	4,590	B.
September	44	26	31.7	1,890	C.
October	126	44	67.3	4,140	B.
November	98	40	83.3	4,960	B.
December	140	56	86.5	5,320	C.
The period				72,700	
1906.					
March 24–31	660	163	434	6,880	B.
April	559	242	331	19,700	B.
May	863	207	392	24,100	B.
June	1,250	712	974	58,000	C.
July	702	76	322	19,800	B.
October	117	86	107	6,580	B.
November 1–16	126	111	116	3,680	B.
The period				139,000	
1907.					
February 15–28	1,040	156	502	14,900	B.
March	1,310	149	348	21,400	B.
April	846	224	489	29,100	B.
May	1,620	258	796	48,900	C.
June	4,010	792	1,460	86,900	D.

SUN RIVER DRAINAGE BASIN.

DESCRIPTION.

Sun River rises on the eastern slope of the Rocky Mountains in northwestern Montana, flows southward for about 60 miles, then, turning abruptly, flows eastward through a canyon, emerging on a level plain, through which it runs for 75 miles to its junction with the Missouri at Great Falls. The area of the drainage basin is about 2,240 square miles.

South Fork and Willow Creek, its only important tributaries, rise in the mountains and are perennial streams. The others are small intermittent streams whose drainage areas lie entirely within the plains region.

The valley of Sun River proper is from 1 to 3 miles wide and the river flows from 5 to 25 feet below its general surface. Steeply sloping bluffs, about 300 feet high, border this valley, and between these bluffs and the adjoining river valley are comparatively smooth bench lands. The highest peak in the mountains stands about 8,900 feet above sea level; the altitude of the river at the canyon where it leaves the mountains is 4,450 feet; at its mouth it is 3,300 feet above sea level.

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A. SUN RIVER CANYON ABOVE POINT OF DIVERSION, SUN RIVER PROJECT, MONTANA

B. SUN RIVER CANYON DIVERSION SITE, SUN RIVER PROJECT, MONTANA

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The mountainous part of the basin is included in the Lewis and Clark National Forest, and is heavily timbered. The plains section is treeless except for a few willows and cottonwoods along the streams.

The mean annual rainfall varies from 12 inches in the plains region to about 45 inches in the mountainous sections. The heaviest rainfall occurs during the month of June, but the regular June floods are caused by the melting snow in the mountains. During the greater part of the winter season all the streams are frozen over.

Much of the land in the valley has been irrigated, and the ordinary summer flow of the stream is practically all utilized. The United States Reclamation Service has started construction on an irrigation project that will store the flood water of Sun River and its tributaries and carry it to the higher bench lands at the north of the valley, where 260,000 acres of irrigable land can be reclaimed. (See Pl. IV.) A number of reservoir sites have been selected, the largest being the Warm Springs reservoir with a capacity of 156,800 acre-feet. The other reservoirs are the Willow Creek, with a capacity of 84,320 acre-feet; the Pishkun, with a capacity of 45,747 acre-feet, and the Benton Lake, with a capacity of 140,200 acre-feet.

Natural power opportunities are good, as Sun River has a minimum flow at the point where it leaves the mountains of 150 second-feet and a fall of about 40 feet to the mile.

The following gaging stations have been maintained in this river basin:

North Fork of Sun River near Augusta, Mont., 1889–90, 1903–1908.
Sun River at Sun River, Mont., 1905–1908.
Sun River near Great Falls, Mont., 1897.
South Fork of Sun River at Augusta, Mont., 1904–1908.
Willow Creek near Augusta, Mont., 1905–1908.
Ford Creek near Augusta, Mont., 1906–1908.
Smith Creek near Augusta, Mont., 1906–1908.

NORTH FORK OF SUN RIVER NEAR AUGUSTA, MONT.

This station, which is situated below the head of the Kilraven ditch, near Christian's ranch, 12 miles northwest of Augusta and 21 miles southwest of Choteau, Mont., was established October 31, 1903, to determine the amount of water available for storage and irrigation.

The only important tributaries are Willow Creek and the South Fork of Sun River, both of which enter several miles below the gaging station. Very little water is diverted above the station, but below nearly all of the valley land is irrigated from this stream.

The gage datum has not been changed since the station was established. Conditions for obtaining accurate discharge data are excellent except during the winter months, when the discharge is affected by ice.

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Discharge measurements of North Fork of Sun River near Augusta, Mont., in 1907 and 1908.

Date	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	Follansbee and Stewart	130	388	1.76	749
May 26	J. E. Stewart	138	559	3.06	2,150
June 13	do	144	763	4.40	4,300
August 2	do	132	504	2.36	1,340
September 19	Follansbee and Stewart	116	330	1.19	408
September 20	do	107	160	(a)	389
1908.					
May 28	Raymond Richards	140	599	3.11	2,160
July 11	do	140	586	2.47	1,690
August 30	do	135	312	.77	390
October 15	do	135	402	1.34	721

a Made at mouth of canyon, 10 miles above regular station. Regular gage read 1.19.

Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1907 and 1908.

[G. B. Christian, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.a												
1	.....	0.9	1.2	0.6	1.6	4.9	4.5	2.4	1.4	.....	0.9	0.7
2	.....	.....	1.0	.6	1.6	5.6	4.4	2.4	1.4	1.1	.9	.7
3	.....	.....	.9	.6	1.6	5.1	4.6	2.3	1.3	1.1	.9	.8
4	.....	.....	.8	.7	1.6	4.6	4.7	2.3	1.3	1.1	.9	.8
5	1.7	.....	.7	1.0	1.6	4.6	4.5	2.3	1.3	1.1	.9	.7
6	.....	.....	.6	1.0	1.5	5.0	4.1	2.2	1.3	1.1	.9	.7
7	.....	.....	.7	1.0	1.5	5.0	3.9	2.1	1.3	1.1	.9	.8
8	.....	2.5	.7	1.0	1.7	5.2	3.7	2.0	1.3	1.0	.9	.7
9	.....	.....	.7	1.1	2.0	4.6	3.9	2.0	1.3	1.0	.9	.8
10	1.7	.....	.7	1.5	2.4	4.4	3.9	2.0	1.2	1.0	.9	.8
11	.....	.....	.7	1.6	3.2	4.0	3.8	1.9	1.2	1.0	.9	.8
12	.....	.....	.6	1.5	3.1	4.2	3.8	1.9	1.3	1.0	.9	.8
13	.....	.....	.6	1.6	3.1	4.3	3.6	1.8	1.3	1.0	.9	.7
14	.....	.....	.6	1.8	3.1	4.0	3.4	1.7	1.2	1.0	.9	.7
15	.....	2.3	.5	2.0	3.4	3.9	3.2	1.7	1.2	1.0	.9	.7
16	.....	.....	.5	2.4	3.7	3.8	3.1	1.7	1.2	1.0	.9	.6
17	1.6	2.0	.5	1.9	4.4	3.6	3.1	1.6	1.2	1.0	.8	.6
18	.....	2.0	.5	1.9	4.4	3.6	3.0	1.6	1.2	1.0	.8	.7
19	.....	1.9	.5	1.8	4.5	3.9	3.0	1.6	1.2	1.0	.8	.7
20	.....	1.8	.6	1.6	5.0	4.3	3.0	1.6	1.2	1.0	.8	.8
21	.....	1.8	.6	1.6	4.5	4.3	3.2	1.5	1.2	1.0	.8	.8
22	.....	1.8	.6	1.8	4.4	4.6	3.3	1.5	1.2	1.0	.8	.7
23	.....	1.7	.6	1.8	3.8	5.3	3.2	1.5	1.2	1.0	.8	.8
24	.....	1.6	.6	1.7	3.5	5.0	3.0	1.5	1.2	1.0	.8	.8
25	.9	1.6	.6	1.6	3.3	4.4	2.9	1.5	1.2	1.0	.8	.8
26	.....	1.5	.6	1.6	3.0	4.5	2.8	1.5	1.1	1.0	.8	.8
27	.....	1.4	.6	1.6	3.4	5.0	2.7	1.5	1.1	1.0	.8	.8
28	.....	1.3	.6	1.5	3.6	5.4	2.6	1.6	1.1	.9	.7	.8
29	.....	.....	.6	1.5	3.8	5.4	2.7	1.5	1.1	.9	.7	.8
30	.....	.....	.6	1.5	3.8	5.0	2.7	1.5	1.1	.9	.7	.8
31	.....	.....	.6	.....	4.0	.....	2.5	1.5	.....	.9	.....	.8
1908.b												
1	.....	.....	.6	.6	2.4	5.2	3.2	1.0	.7	.8	.7	.8
2	.....	.....	.6	.6	2.7	5.5	3.2	1.0	.7	.8	.7	.8
3	.6	.....	.6	.6	2.8	4.8	3.2	1.0	.7	.8	.7	.8
4	.....	.....	.6	.6	2.8	6.5	3.1	1.0	.7	.8	.7	.8
5	.....	.....	.6	.6	2.8	6.5	3.0	1.0	.7	.8	.7	.8
6	.....	.....	.6	.6	3.1	(c)	2.8	1.0	.7	.7	.7	.8
7	.....	.6	.6	.6	3.6	(c)	2.8	.9	.7	.7	.7	.8
8	.....	.....	.7	.6	3.9	(c)	2.8	.9	.7	.7	.7	.8
9	.6	.....	.7	.7	3.4	6.5	2.7	.9	.7	.7	.7	.8
10	.....	.....	.7	.7	3.5	6.2	2.7	.9	.7	.7	.7	.8

a River frozen entirely across January 1 to February 16, 1907. Recorded gage readings are to water surface.

b [redacted] frozen January 1 to about March 10, and December 21–31, 1908.

c [redacted] over top of gage June 6, 7, 8, 1908. From high-water marks the extreme high stage was found to be [redacted]. Discharge estimated as 15,000 second-feet.

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Daily gage height, in feet, of North Fork of Sun River near Augusta, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]												
11	.....	.....	0.7	0.8	3.5	6.0	2.7	0.8	0.7	0.7	0.7	0.8
12	.....	.....	.8	1.0	3.4	5.6	2.6	.8	.7	.7	.7	.8
13	.....	.....	.9	1.2	3.2	5.2	2.6	.8	.7	.7	.7	.8
14	.....	0.6	.9	1.5	3.2	4.8	2.5	.8	.7	.7	.7	.8
15	.....	.....	.9	1.3	3.3	4.6	2.5	.8	.7	.7	.7	.8
16	.....	.....	.9	1.2	3.6	4.5	2.4	.8	.8	.7	.7	.8
17	0.6	.....	.9	1.7	3.4	4.4	2.3	.8	.9	.7	.7	.8
18	.....	.....	.9	2.0	3.1	4.1	2.2	.8	.9	.7	.7	.8
19	.....	.....	.8	2.3	3.1	3.9	1.9	.8	.9	.7	.7	.8
20	.....	.....	.8	2.6	3.0	3.6	1.8	.7	.9	.7	.7	.8
21	.....	.6	.8	2.9	2.9	3.4	1.8	.7	.9	.7	.7	.....
22	.....	.....	.7	2.9	2.9	3.2	1.7	.7	.8	.7	.7	.....
23	.....	.....	.7	2.9	2.8	3.2	1.6	.7	.8	.7	.8	.....
24	.6	.....	.7	3.0	2.9	3.2	1.5	.7	.8	.7	.8	.....
25	.....	.....	.7	2.9	3.2	3.6	1.5	.7	.8	.7	.8	.....
26	.....	.....	.7	2.8	3.2	4.0	1.4	.7	.8	.7	.8	.9
27	.....	.....	.7	2.6	3.1	3.7	1.3	.7	.8	.7	.8	.....
28	.....	.6	.7	2.5	3.1	3.2	1.2	.7	.8	.7	.8	.....
29	.....	.....	.7	2.2	3.1	3.0	1.2	.7	.8	.7	.8	.....
30	.....	.....	.7	2.0	3.2	3.0	1.1	.7	.8	.7	.8	.....
31	.9	.....	.7	.....	3.8	.....	1.0	.7	.....	.7	.....	1.1

[a] River frozen January 1 to about March 10, and December 21–31, 1908.

Rating tables for North Fork of Sun River near Augusta, Mont.

JANUARY 1, 1907, TO JUNE 7, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	150	1.80	795	3.10	2,220	4.80	4,980
.60	180	1.90	875	3.20	2,360	5.00	5,360
.70	210	2.00	900	3.30	2,500	5.20	5,740
.80	245	2.10	1,050	3.40	2,650	5.40	6,130
.90	285	2.20	1,145	3.50	2,800	5.60	6,530
1.00	325	2.30	1,255	3.60	2,950	5.80	6,930
1.10	370	2.40	1,360	3.70	3,100	6.00	7,330
1.20	420	2.50	1,470	3.80	3,260	6.20	7,750
1.30	470	2.60	1,580	3.90	3,420	6.40	8,170
1.40	525	2.70	1,700	4.00	3,580	6.60	8,590
1.50	585	2.80	1,820	4.20	3,920		
1.60	650	2.90	1,950	4.40	4,260		
1.70	720	3.00	2,080	4.60	4,620		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907–8 and the form of previous curves and is well defined below gage height 5 feet.

JUNE 8, TO DECEMBER, 1908.

0.50	289	1.80	1,040	3.10	2,570	4.80	5,440
.60	325	1.90	1,120	3.20	2,720	5.00	5,820
.70	365	2.00	1,210	3.30	2,870	5.20	6,200
.80	409	2.10	1,300	3.40	3,030	5.40	6,580
.90	457	2.20	1,400	3.50	3,190	5.60	6,960
1.00	509	2.30	1,510	3.60	3,350	5.80	7,360
1.10	565	2.40	1,620	3.70	3,510	6.00	7,760
1.20	624	2.50	1,740	3.80	3,680	6.20	8,160
1.30	686	2.60	1,870	3.90	3,850	6.40	8,560
1.40	751	2.70	2,000	4.00	4,020	6.60	8,960
1.50	820	2.80	2,140	4.20	4,360		
1.60	890	2.90	2,280	4.40	4,720		
1.70	960	3.00	2,420	4.60	5,080		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made after the high water of 1908 and the general form of previous curves and is well defined below gage height 3.0 feet.

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Monthly discharge of North Fork of Sun River near Augusta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	.....	.....	a 230	14,100	D.
February	.....	.....	421	23,400	C.
March	420	150	199	12,200	B.
April	1,300	180	596	35,500	A.
May	3,360	585	2,440	150,000	A.
June	6,530	2,950	4,630	276,000	A.
July	4,800	1,470	2,780	171,000	A.
August	1,360	585	818	50,300	A.
September	525	370	434	25,800	A.
October	370	285	330	20,300	B.
November	285	210	263	15,600	C.
December	245	180	228	14,000	D.
The year	6,530	.....	1,110	808,000	
1908.					
March 11–31	285	210	238	9,910	D.
April	2,000	180	856	50,900	A.
May	3,430	1,360	2,320	143,000	A.
June	a 15,000	2,430	5,710	340,000	B.
July	2,730	580	1,540	94,700	A.
August	580	365	418	25,700	A.
September	451	365	395	23,500	B.
October	400	365	372	22,900	B.
November	400	365	371	22,400	C.
December 1–20	400	400	400	16,200	D.
The period	.....	.....	.....	730,000	

a Estimated.

SUN RIVER AT SUN RIVER, MONT.

This station, which is located at the highway bridge over Sun River, Mont., was established July 31, 1905, to obtain data for use in connection with irrigation projects. The records at this station do not show the total run-off from the drainage area above it, as [illegible] the entire valley above is irrigated from this stream. [illegible] of part of the summer flow is utilized for irrigation.

The [illegible] has not been changed since the station was established. The [illegible] is affected at times during the winter by ice. The [illegible] the bridge has been very good since the high [illegible] Fair [illegible] measurements can be made by [illegible].

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	Discharge.
				Sec.-ft.
[illegible]	[illegible]	[illegible]	[illegible]	1,100
[illegible]	[illegible]	[illegible]	[illegible]	3,700
[illegible]	[illegible]	[illegible]	[illegible]	3,730
[illegible]	[illegible]	[illegible]	[illegible]	3,660
[illegible]	[illegible]	[illegible]	[illegible]	2,500
[illegible]	[illegible]	[illegible]	[illegible]	1,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	554
[illegible]	[illegible]	[illegible]	[illegible]	348
[illegible]	[illegible]	[illegible]	[illegible]	357
[illegible]	[illegible]	[illegible]	[illegible]	2,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	4,150
[illegible]	[illegible]	[illegible]	[illegible]	4,530
[illegible]	[illegible]	[illegible]	[illegible]	1,[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	516
[illegible]	[illegible]	[illegible]	[illegible]	340

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Daily gage height, in feet, of Sun River at Sun River, Mont., for 1907 and 1908.

[R. A. Lange, observer.]

Day.[a]	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	5.20	3.60	2.70	3.60	3.40	7.00	8.20	4.60	3.30	2.75	2.30	2.55
2	5.20	3.65	2.75	3.60	3.40	8.40	7.90	4.20	3.00	2.75	2.35	2.55
3	5.20	3.65	2.75	3.60	3.50	8.20	7.60	4.30	3.00	2.75	2.50	2.55
4	5.20	3.65	2.75	3.80	3.90	7.60	7.60	4.25	3.00	2.75	2.50	2.55
5	5.20	3.65	2.75	3.75	3.90	7.70	7.40	4.00	3.00	2.70	2.50	2.55
6	4.50	3.65	2.60	3.70	3.90	7.90	7.60	4.00	3.00	2.65	2.50	2.55
7	4.50	3.75	2.60	3.65	3.90	7.90	6.90	4.00	3.00	2.65	2.50	2.55
8	4.10	7.95	2.65	3.60	4.90	8.40	6.60	4.10	3.00	2.60	2.50	2.80
9	4.10	7.95	2.65	3.60	4.95	8.00	6.60	4.00	3.00	2.60	2.55	2.80
10	4.00	7.00	2.65	3.70	5.00	7.00	7.00	4.00	3.00	2.60	2.55	2.90
11	3.50	6.50	2.60	3.65	6.00	6.60	6.90	3.90	2.95	2.60	2.55	2.90
12	3.50	5.95	2.70	3.70	6.00	7.00	6.60	3.90	2.95	2.60	2.55	2.85
13	3.50	4.60	2.70	3.80	6.00	7.00	6.60	3.80	2.95	2.60	2.55	2.85
14	3.50	4.50	2.70	4.00	6.50	6.90	6.20	3.85	2.95	2.60	2.50	2.80
15	3.50	4.50	2.65	4.00	5.95	6.60	6.00	3.70	2.95	2.50	2.50	2.80
16	3.20	4.50	2.70	4.00	6.50	6.40	5.90	3.50	2.95	2.50	2.50	2.80
17	3.50	4.50	2.68	4.00	6.65	6.00	5.70	3.50	2.95	2.50	2.55	2.80
18	3.60	3.50	2.68	4.00	7.00	6.00	5.70	3.50	2.95	2.50	2.55	2.80
19	3.60	3.50	2.68	3.90	7.40	6.00	5.60	3.40	2.95	2.50	2.50	2.70
20	3.60	3.00	2.70	3.40	8.00	6.60	5.40	3.40	2.90	2.50	2.50	2.70
21	3.65	3.00	2.70	3.40	7.60	6.90	5.60	3.40	2.80	2.45	2.50	2.75
22	3.50	3.00	2.95	3.60	7.00	7.00	5.60	3.00	2.80	2.45	2.50	2.80
23	3.60	3.00	2.95	3.90	6.60	7.40	5.60	3.00	2.80	2.45	2.50	2.80
24	3.60	2.65	2.95	3.90	6.10	9.60	5.50	3.00	2.80	2.45	2.50	2.80
25	3.60	2.60	2.95	3.70	6.00	9.40	5.40	3.00	2.80	2.40	2.52	2.80
26	3.60	2.60	2.95	3.90	5.80	8.60	5.40	3.00	2.80	2.40	2.52	2.80
27	3.60	2.60	2.95	3.90	5.50	8.00	5.40	3.00	2.80	2.40	2.55	2.80
28	3.60	2.65	2.95	3.90	5.50	8.60	4.80	3.20	2.80	2.40	2.55	2.80
29	3.70	.....	2.90	3.40	5.50	8.00	4.80	4.00	2.80	2.40	2.55	2.80
30	3.50	.....	2.85	3.40	6.40	8.60	4.50	3.90	2.78	2.40	2.55	2.75
31	3.55	.....	2.85	.....	6.90	.....	4.70	3.60	.....	2.30	.....	2.75
1908.[b]												
1	2.75	5.0	2.0	2.0	3.8	8.5	6.0	3.95	3.15	3.6	3.5	3.0
2	2.80	4.2	2.0	2.0	4.0	9.8	6.0	3.8	3.1	3.6	3.45	3.0
3	2.78	4.2	2.0	2.0	4.5	8.75	6.0	3.8	3.0	3.65	3.4	3.0
4	2.50	4.2	1.95	2.0	5.0	9.8	6.0	3.65	3.0	3.55	3.4	3.0
5	2.80	4.2	1.95	2.0	4.8	12.0	6.0	3.5	3.0	3.5	3.3	3.0
6	2.78	4.2	2.0	2.0	5.2	12.5	6.0	3.5	3.0	3.5	3.3	3.2
7	2.75	4.2	2.0	2.0	5.9	12.0	5.95	3.5	3.0	3.5	3.3	3.1
8	2.75	4.2	2.0	2.0	6.4	13.0	5.95	3.4	3.0	3.5	3.3	3.1
9	2.75	4.5	2.0	2.0	6.0	11.5	5.5	3.2	3.0	3.4	3.2	3.1
10	2.75	4.5	2.0	2.0	6.0	9.5	5.4	3.0	3.0	3.4	3.2	3.2
11	2.75	4.5	2.0	2.0	6.0	9.3	5.3	3.0	2.95	3.4	3.2	3.2
12	3.00	4.5	2.0	2.5	5.9	8.5	5.3	2.95	2.95	3.15	3.15	3.2
13	3.00	4.4	2.0	2.8	5.6	8.0	5.0	2.9	2.95	3.15	3.1	3.0
14	2.9	4.25	2.0	3.2	5.95	8.0	5.2	3.0	2.95	3.15	3.1	3.0
15	2.9	4.3	2.0	3.1	5.95	8.0	5.15	3.0	2.95	3.15	3.5	3.0
16	2.85	.....	2.0	3.8	6.0	8.0	5.1	3.0	3.2	3.65	3.5	3.0
17	2.7	4.0	2.0	3.6	6.0	8.0	5.0	3.5	3.2	3.6	3.5	3.0
18	2.8	4.0	2.1	3.6	5.4	7.5	5.0	3.0	3.5	3.5	3.5	3.0
19	2.8	3.95	2.1	4.0	5.45	7.1	4.95	2.85	3.5	3.5	3.5	3.0
20	2.9	2.9	2.1	4.5	5.35	7.0	4.7	2.85	3.45	3.5	3.5	3.0
21	2.9	2.9	2.0	5.0	5.35	7.0	4.5	2.85	3.45	3.65	3.5	3.0
22	3.0	2.9	2.0	5.0	5.25	6.9	4.35	2.8	3.45	3.65	3.4	2.85
23	3.0	3.5	2.0	5.9	5.2	6.6	4.35	2.75	3.45	3.65	3.3	2.85
24	2.95	3.0	2.0	5.4	5.2	6.5	4.35	2.7	3.45	3.65	3.3	2.8
25	3.0	3.0	2.0	5.0	5.2	6.4	4.2	4.0	3.5	3.6	3.25	2.8
26	2.9	2.9	2.0	4.8	5.0	7.0	4.0	3.7	3.5	3.6	3.0	2.8
27	3.5	2.5	2.0	4.6	5.2	6.8	4.0	2.85	3.5	3.6	3.0	2.75
28	3.6	2.5	2.0	4.0	5.9	6.5	4.0	3.15	3.55	3.5	3.0	2.75
29	3.7	2.5	2.0	3.1	6.0	6.3	4.0	3.15	3.6	3.5	3.0	2.7
30	4.8	.....	2.0	3.1	5.95	6.0	3.95	3.15	3.6	3.4	3.0	2.7
31	5.0	.....	2.0	.....	7.0	.....	3.95	3.15	.....	3.4	.....	2.7

[a] Ice conditions for about January 10, February 12, and part of December, 1907.
[b] Ice conditions during February, 1908.
[c] The maximum flood gage height on June 7, 1908, was 13.4 feet.

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Rating tables for Sun River at Sun River, Mont.

JANUARY 1 TO JUNE 8, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.60	410	3.80	985	5.00	1,980	6.40	3,580
2.70	440	3.90	1,050	5.10	2,060	6.60	3,820
2.80	475	4.00	1,120	5.20	2,160	6.80	4,090
2.90	510	4.10	1,190	5.30	2,260	7.00	4,370
3.00	550	4.20	1,260	5.40	2,370	7.20	4,660
3.10	595	4.30	1,340	5.50	2,480	7.40	4,960
3.20	640	4.40	1,420	5.60	2,590	7.60	5,270
3.30	690	4.50	1,500	5.70	2,700	7.80	5,590
3.40	745	4.60	1,590	5.80	2,820	8.00	5,920
3.50	800	4.70	1,680	5.90	2,940	8.20	6,260
3.60	860	4.80	1,770	6.00	3,060	8.40	6,600
3.70	920	4.90	1,860	6.20	3,300		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the form of the curve after high water. It is not well defined.

JUNE 9 TO SEPTEMBER 20, 1907.

2.30	186	3.70	729	5.10	1,890	7.00	4,270
2.40	210	3.80	788	5.20	2,000	7.20	4,570
2.50	235	3.90	850	5.30	2,110	7.40	4,880
2.60	262	4.00	915	5.40	2,220	7.60	5,200
2.70	292	4.10	985	5.50	2,330	7.80	5,520
2.80	323	4.20	1,060	5.60	2,440	8.00	5,860
2.90	358	4.30	1,140	5.70	2,560	8.20	6,200
3.00	395	4.40	1,220	5.80	2,680	8.40	6,550
3.10	435	4.50	1,310	5.90	2,800	8.60	6,910
3.20	478	4.60	1,400	6.00	2,920	8.80	7,280
3.30	523	4.70	1,490	6.20	3,170	9.00	7,660
3.40	570	4.80	1,590	6.40	3,430	9.20	8,050
3.50	620	4.90	1,690	6.60	3,700		
3.60	673	5.00	1,790	6.80	3,980		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during the above period and is well defined below gage height 7.0 feet. Above gage height 9.2 feet the curve is a tangent, the difference being 200 per tenth.

SEPTEMBER 21 TO DECEMBER 31, 1907.

[The indirect method applied, the previous curve being used as standard.]

JANUARY 1 TO AUGUST 8, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	78	3.30	523	4.70	1,490	7.20	4,710
2.00	100	3.40	570	4.80	1,590	7.40	5,040
2.10	124	3.50	620	4.90	1,690	7.60	5,380
2.20	149	3.60	673	5.00	1,790	7.80	5,740
2.30	175	3.70	729	5.20	2,000	8.00	6,110
2.40	202	3.80	788	5.40	2,220	8.20	6,490
2.50	231	3.90	850	5.60	2,440	8.40	6,870
2.60	261	4.00	915	5.80	2,680	8.60	7,270
2.70	292	4.10	985	6.00	2,930	8.80	7,670
2.80	323	4.20	1,060	6.20	3,200	9.00	8,070
2.90	358	4.30	1,140	6.40	3,480	10.00	10,220
3.00	395	4.40	1,220	6.60	3,780	11.00	12,500
3.10	435	4.50	1,310	6.80	4,080	12.00	14,900
3.20	478	4.60	1,400	7.00	4,390	13.00	17,400

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907-8 and is well defined below gage height 9.0 feet. Above 9.0 feet the curve is somewhat uncertain.

AUGUST 9 TO DECEMBER 31, 1908.

[Indirect method for shifting channels used.]

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Daily discharge, in second-feet, of Sun River at Sun River, Mont., for 1907 and 1908.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1907.					1907.				
1	.....	350	255	350	16	.....	280	328	430
2	.....	355	270	350	17	.....	290	345	430
3	.....	355	320	350	18	.....	290	345	430
4	.....	355	320	350	19	.....	290	330	395
5	.....	335	320	350	20	.....	290	330	395
6	.....	315	320	350	21	340	290	330	410
7	.....	325	320	350	22	340	285	330	430
8	.....	310	320	430	23	340	285	330	430
9	.....	310	340	430	24	340	285	330	430
10	.....	310	340	475	25	340	268	340	430
11	.....	310	340	475	26	340	268	340	430
12	.....	315	340	455	27	360	280	350	430
13	.....	315	340	455	28	360	280	350	430
14	.....	315	328	430	29	360	280	350	430
15	.....	280	328	430	30	355	280	350	410
					31	.....	245	.....	410

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.						1908.					
1	.....	480	620	560	350	16	415	478	615	560	350
2	.....	455	620	535	350	17	645	478	590	560	350
3	.....	415	645	515	350	18	435	620	540	560	350
4	.....	415	595	515	350	19	375	620	540	560	350
5	.....	415	570	470	350	20	375	595	540	560	350
6	.....	415	570	470	425	21	375	565	620	560	350
7	.....	415	570	470	390	22	360	565	620	515	300
8	.....	415	570	470	390	23	340	565	620	470	300
9	500	415	520	425	390	24	325	565	620	470	290
10	415	415	520	425	425	25	965	590	605	450	290
11	415	375	520	425	425	26	782	590	605	350	290
12	390	375	400	405	425	27	375	590	605	350	285
13	370	375	400	390	350	28	480	620	560	350	285
14	415	375	400	390	350	29	480	645	560	350	280
15	415	375	400	560	350	30	480	645	515	350	280
						31	480	.....	515	.....	280

Monthly discharge of Sun River at Sun River, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	.....	.....	a 400	24,600	D.
February	.....	.....	a 750	41,700	D.
March	530	410	463	28,500	C.
April	1,120	745	947	56,400	B.
May	5,920	745	2,860	176,000	B.
June	8,850	2,920	5,210	310,000	B.
July	6,200	1,310	3,250	200,000	B.
August	1,400	395	747	45,900	B.
September	523	340	376	22,400	B.
October	355	245	301	18,500	B.
November	350	255	329	19,600	C.
December	475	350	412	25,300	D.
The year	8,850	.....	1,340	969,000	

a Estimated.

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Monthly discharge of Sun River at Sun River, Mont., for 1907 and 1908—Continued.

Month.	Discharged in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
January	1,790	231	457	28,100	D.
March	124	89	102	6,270	C.
April	2,800	100	736	43,800	B.
May	4,390	788	2,380	146,000	A.
June	17,400	2,930	7,290	434,000	B.
July	2,930	882	1,870	115,000	B.
August	965	325	522	32,100	B.
September	645	375	495	29,500	B.
October	645	400	555	34,100	B.
November	580	350	468	27,800	C.
December	425	280	344	21,200	D.
The period				918,000	

SOUTH FORK OF SUN RIVER AT AUGUSTA, MONT.

This station, which is located at the highway bridge on the road from Augusta to Craig, Mont., about one-half mile from Augusta, was established December 2, 1904, to obtain run-off data for use in connection with the Sun River Irrigation project.

Water is diverted to irrigate the valley lands, both above and below the stations. During dry seasons the entire summer flow is utilized.

The original gage was spiked to the crib work of the right abutment on the downstream side of the bridge. On April 17, 1907, a new gage was established 100 yards above the bridge. This gage is spiked to a tree on the left bank and is set at a different datum. The gage heights are affected by ice during the winter.

Discharge measurements of South Fork of Sun River at Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.[a]		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	Follansbee and Stewart	32	49.4	[b] 2.05	106
May 24	J. E. Stewart	35	91	2.96	309
June 12	do	34	67	2.60	247
June 26	do	85	296	4.11	1,120
August 1	do	34	54	2.11	124
September 18	Follansbee and Stewart	32	36.9	1.80	45.7
1908.					
May 4	Stewart and Richards	26	17.7	1.48	10.8
May 27	Raymond Richards	69	192	3.36	652
June 18	J. E. Stewart	70	178	3.70	[d] 475
July 11	Raymond Richards	52	42.1	2.92	[c] 105
August 28	do	21	21	2.45	[c] 51.1
October 17	do	30	28.6	2.83	81.6

[a] Measurements were made at different sections.
[b] Old gage read 1.27.
[c] Made by wading.
[d] Old gage on bridge read 1.96.

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Daily gage height, in feet, of South Fork of Sun River at Augusta, Mont., for 1907 and 1908.

[Richard Auchard, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	1.0	1.1	2.1	3.2	2.95	2.1	1.8	1.8	1.7	1.7
2	.....	1.0	1.1	2.1	3.25	2.8	2.1	1.8	1.8	1.7	1.7
3	.....	1.0	1.2	2.1	3.25	2.7	2.0	1.8	1.8	1.7	1.7
4	.....	1.0	1.2	2.1	3.2	2.7	2.0	1.8	1.8	1.7	1.7
5	.....	1.0	1.2	2.2	3.1	2.6	2.0	1.8	1.8	1.7	1.7
6	.....	1.0	1.2	2.2	3.0	2.55	2.0	1.8	1.75	1.7	1.7
7	.....	1.0	1.2	2.2	2.9	2.5	2.0	1.8	1.75	1.7	1.7
8	2.25	1.0	1.2	2.3	2.9	2.5	2.0	1.8	1.75	1.7	1.7
9	3.1	1.0	1.2	2.3	2.8	2.5	2.0	1.75	1.75	1.7	1.7
10	2.5	1.0	1.2	2.3	2.7	2.6	2.0	1.75	1.75	1.7	1.7
11	2.3	1.0	1.2	2.5	2.6	2.5	2.0	1.75	1.75	1.7	1.7
12	2.0	1.0	1.2	2.5	2.6	2.5	1.9	1.75	1.75	1.7	1.7
13	1.5	.9	1.2	2.5	2.6	2.4	1.9	1.8	1.75	1.7	1.7
14	1.3	.9	1.2	2.5	2.5	2.4	1.9	1.8	1.75	1.7	1.7
15	1.3	.9	1.3	2.5	2.5	2.35	1.9	1.8	1.75	1.7	1.7
16	1.3	1.0	1.25	2.5	2.5	2.35	1.9	1.8	1.75	1.7	.....
17	1.2	1.0	1.25	2.8	2.4	2.3	1.9	1.8	1.75	1.7	.....
18	1.1	1.1	1.3	2.85	2.35	2.3	1.9	1.8	1.75	1.7	.....
19	1.1	1.1	1.3	3.1	2.3	2.3	1.9	1.8	1.75	1.7	.....
20	1.1	1.1	2.0	3.1	2.25	2.4	1.9	1.8	1.75	1.7	.....
21	1.1	1.1	2.0	3.1	3.45	2.4	1.9	1.75	1.75	1.7	.....
22	1.1	1.1	2.0	3.1	3.55	2.4	1.9	1.75	1.7	1.7	.....
23	1.1	1.1	2.0	3.1	4.85	2.35	1.9	1.75	1.7	1.7	.....
24	1.1	1.1	2.0	3.0	4.9	2.3	1.9	1.75	1.7	1.7	.....
25	1.1	1.1	2.05	2.85	4.3	2.2	1.9	1.75	1.7	1.7	.....
26	1.1	1.1	2.05	2.8	4.1	2.2	1.9	1.75	1.7	1.7	.....
27	1.0	1.1	2.0	2.75	.....	2.2	1.9	1.75	1.7	1.7	.....
28	1.0	1.1	2.0	2.9	3.4	2.1	1.8	1.75	1.7	1.7	.....
29	.....	1.1	2.0	2.95	3.2	2.1	1.8	1.8	1.7	1.7	.....
30	.....	1.1	2.0	3.1	3.15	2.1	1.8	1.8	1.7	1.7	.....
31	.....	1.1	.....	3.2	.....	2.1	1.8	.....	1.7	.....	.....
1908.											
1	.....	.....	1.70	1.50	5.45	3.3	2.5	2.4	2.5	2.75	.....
2	.....	.....	1.70	1.50	6.8	3.3	2.5	2.4	2.55	2.75	.....
3	.....	.....	1.70	1.50	5.8	3.12	2.5	2.4	2.55	2.7	.....
4	.....	.....	1.70	1.45	5.3	3.2	2.45	2.35	2.6	2.7	.....
5	.....	.....	1.70	1.45	5.4	3.2	2.45	2.35	2.6	2.65	.....
6	.....	.....	1.70	1.40	6.0	3.15	2.4	2.35	2.65	2.65	.....
7	.....	.....	1.70	1.30	5.85	3.1	2.4	2.3	2.65	2.6	.....
8	.....	.....	1.70	1.40	5.75	3.05	2.4	2.3	2.65	2.6	.....
9	.....	.....	1.70	1.50	5.70	3.0	2.35	2.25	2.6	2.6	.....
10	.....	.....	1.70	1.90	4.92	3.0	2.35	2.25	2.6	2.6	.....
11	.....	.....	1.70	1.90	4.80	3.0	2.35	2.25	2.6	2.4	.....
12	.....	.....	1.70	2.00	4.60	2.95	2.35	2.25	2.6	2.2	.....
13	.....	.....	1.70	2.10	4.40	2.95	2.5	2.25	2.65	2.7	.....
14	.....	1.8	1.70	2.10	4.40	2.9	2.8	2.25	2.7	2.7	.....
15	.....	1.8	1.70	2.20	3.90	2.9	2.5	2.25	2.75	2.9	.....
16	.....	1.8	1.70	2.30	3.80	2.9	2.5	2.3	2.8	2.8	.....
17	.....	1.7	1.70	2.30	3.75	2.9	2.5	2.4	2.8	2.6	.....
18	.....	1.7	1.70	2.30	3.65	2.85	2.5	2.6	2.9	2.7	.....
19	.....	1.7	1.70	2.30	3.65	2.85	2.5	2.5	2.9	2.6	.....
20	.....	1.7	1.70	2.30	3.70	2.7	2.5	2.4	2.9	2.6	.....
21	.....	1.7	1.70	2.40	3.70	2.7	2.5	2.4	2.9	2.7	.....
22	.....	1.7	1.60	2.50	3.65	2.7	2.5	2.4	2.85	2.7	.....
23	.....	1.7	1.60	2.50	3.65	2.7	2.5	2.4	2.85	2.7	.....
24	.....	1.7	1.60	2.50	3.60	2.7	2.5	2.4	2.85	.....	.....
25	.....	1.7	1.60	2.50	3.50	2.65	2.5	2.45	2.85	.....	.....
26	.....	1.7	1.60	2.60	3.40	2.65	2.5	2.45	2.85	.....	.....
27	.....	1.7	1.60	3.20	3.40	2.6	2.5	2.45	2.8	.....	.....
28	.....	1.8	1.55	3.10	3.40	2.6	2.45	2.45	2.8	.....	.....
29	.....	1.8	1.55	3.00	3.40	2.55	2.45	2.45	2.8	.....	.....
30	.....	1.8	1.55	3.10	3.35	2.5	2.45	2.45	2.8	.....	.....
31	.....	1.8	.....	3.60	.....	2.5	2.45	.....	2.8	.....	.....

NOTE.—Beginning April 20, 1907, the gage heights refer to a new gage with a different datum.
Ice conditions January 1 to February 12 (about) and December 16–31, 1907; January 1 to March 31 and November 13 to December 31, 1908.

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Rating tables for South Fork of Sun River at Augusta, Mont.

JANUARY 1 TO APRIL 19, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	46	1.10	75	1.30	113	1.50	159
1.00	59	1.20	93	1.40	135		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1907, which cover the range of stage for this period. It is only approximate.

APRIL 20, 1907, TO JUNE 9, 1908.

1.30	2	2.50	232	3.70	834	4.90	1,810
1.40	6	2.60	266	3.80	904	5.00	1,905
1.50	12	2.70	302	3.90	976	5.20	2,110
1.60	21	2.80	340	4.00	1,050	5.40	2,340
1.70	33	2.90	381	4.10	1,126	5.60	2,590
1.80	48	3.00	425	4.20	1,204	5.80	2,850
1.90	66	3.10	472	4.30	1,284	6.00	3,130
2.00	87	3.20	523	4.40	1,366	6.20	3,410
2.10	111	3.30	578	4.50	1,450	6.40	3,700
2.20	138	3.40	637	4.60	1,536	6.60	4,000
2.30	168	3.50	700	4.70	1,624	6.80	4,300
2.40	200	3.60	766	4.80	1,715		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the above period and is fairly well defined below gage height 4.3 feet.

JUNE 10 TO DECEMBER 31, 1908.

2.20	30	2.90	99	3.60	381	4.30	962
2.30	36	3.00	120	3.70	450	4.40	1,062
2.40	43	3.10	145	3.80	526	4.50	1,167
2.50	51	3.20	178	3.90	609	4.60	1,272
2.60	60	3.30	217	4.00	692	4.70	1,382
2.70	70	3.40	264	4.10	777	4.80	1,492
2.80	83	3.50	319	4.20	867	4.90	1,607

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on four discharge measurements made during the above period and the general shape of the previous high-water curve. It is not well defined.

Monthly discharge of South Fork of Sun River at Augusta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	.....	.....	20.0	1,230	D.
February	.....	.....	97.3	5,400	D.
March	75	46	65.0	4,000	C.
April	113	75	93.1	5,540	C.
May	523	111	292	18,000	A.
June	1,810	153	552	32,800	A.
July	403	111	205	12,600	A.
August	111	48	72.7	4,470	B.
September	48	40	44.8	2,670	B.
October	48	33	39.0	2,400	B.
November	33	33	33.0	1,960	C.
December	33	.....	26.3	1,620	D.
The year	1,810	.....	.....	92,700	

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Monthly discharge of South Fork of Sun River at Augusta, Mont., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
April	33	16	28.9	1,720	C.
May	766	2	172	10,600	B.
June	4,300	240	1,280	76,200	B.
July	217	51	107	6,580	B.
August	83	40	49.1	3,020	C.
September	60	33	41.3	2,460	C.
October	99	51	76.2	4,690	B.
November (1-12)	76	30	61.2	1,460	B.
The period				107,000	

NOTE.—Discharge estimated for ice periods in 1907.

WILLOW CREEK NEAR AUGUSTA, MONT.

Willow Creek rises on the eastern slopes of the Rocky Mountains in the northwestern part of Lewis and Clark County, Mont., and flows in a general northeasterly direction to its junction with Sun River.

The gaging station, which is located at Jordan's ranch just below the mouth of Little Willow Creek, about 7 miles northwest of Augusta, Mont., was established June 8, 1905, to obtain run-off data for use in connection with the Sun River irrigation project. Willow Creek dam, work on which has been begun, will provide a reservoir with a capacity of 84,320 acre-feet.

Much of the valley land above the station is irrigated, the water being taken from this stream.

Conditions for obtaining accurate discharge data are excellent. No ice forms at this station, as a large spring enters the creek just above the gage. The datum of the gage has not been changed.

Discharge measurements of Willow Creek near Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	Follansbee and Stewart	13	16.0	1.32	27.6
May 25	J. E. Stewart	16	38.4	2.73	90.0
June 13	do	16	39.0	2.56	76.0
June 27	do	26	49.0	4.42	170
August 2	do	14	20.4	1.62	37.9
September 19	Follansbee and Stewart	14	11.8	.95	14.1
1908.					
May 5	Stewart and Richards	12	8.4	.75	8.6
May 28	Raymond Richards	25	40.0	3.10	107
June 19	J. E. Stewart	26	45.6	3.94	166
July 11	Raymond Richards	15	23.8	1.78	40.8
August 30	do	14	13.1	1.00	14.9
October 15	do	17	10.0	.92	12.8

NOTE.—Measurements on May 28 and June 19, 1908, made from wagon bridge. All others made by wading at various sections.

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Daily gage height, in feet, of Willow Creek near Augusta, Mont., for 1907 and 1908.

[S. N. Jordan, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.68	0.65	1.20	1.30	1.60	3.05	3.70	1.60	1.10	0.95	0.80	0.82
2	.68	.65	1.02	1.25	1.50	3.25	3.50	1.60	1.10	.95	.80	.82
3	.70	.62	1.18	1.45	1.60	3.15	3.40	1.55	1.05	.92	.78	.90
4	.70	.62	1.18	1.35	1.58	3.05	3.25	1.50	1.05	.90	.78	.95
5	.70	.65	1.30	1.35	1.58	2.90	3.10	1.48	1.05	.90	.78	.90
6	.70	.65	1.22	1.30	1.55	2.95	2.95	1.42	1.05	1.02	.78	.90
7	.70	.68	1.35	1.30	1.58	3.15	2.75	1.42	1.05	1.00	.78	.90
8	.68	6.08	1.18	1.28	1.60	3.00	2.70	1.42	1.08	.90	.78	.85
9	.68	4.45	1.20	1.35	1.75	2.90	2.72	1.40	1.05	.85	.78	.85
10	.68	3.32	1.42	1.38	1.75	2.80	2.80	1.40	1.05	.85	.80	.88
11	.65	3.28	1.18	1.45	2.10	2.70	2.65	1.40	1.05	.85	.80	.88
12	.60	2.00	1.18	1.40	2.00	2.65	2.50	1.30	1.10	.85	.80	.88
13	.60	1.78	1.18	1.40	2.05	2.50	2.65	1.30	1.10	.82	.80	.85
14	.60	1.70	1.38	1.42	2.02	2.38	2.50	1.25	1.10	.82	.80	.80
15	.60	1.55	1.28	1.45	2.05	2.55	2.30	1.20	1.08	.82	.80	.65
16	.62	1.62	1.20	1.40	2.20	2.50	2.35	1.20	1.00	.82	.85	.72
17	.62	1.55	1.25	1.40	2.35	2.25	2.25	1.20	1.00	.82	.80	.65
18	.62	1.38	1.35	1.42	2.55	2.10	2.20	1.18	1.00	.82	.70	.65
19	.62	1.32	1.65	1.28	2.58	2.00	2.15	1.18	.95	.82	.90	.60
20	.62	1.45	1.52	1.25	3.00	1.98	2.10	1.15	.95	.82	.88	.60
21	.62	1.42	1.60	1.25	2.85	2.40	2.15	1.12	.95	.82	.95	.65
22	.62	1.48	1.35	1.25	3.00	3.40	2.20	1.05	.95	.82	.95	.75
23	.70	1.42	1.28	1.40	3.00	5.38	2.00	1.05	.92	.82	.88	.75
24	.65	1.58	1.25	1.40	2.85	5.40	1.95	1.05	.90	.82	.95	.75
25	.65	1.18	1.20	1.35	2.72	4.95	1.82	1.02	.90	.82	.90	.75
26	.65	1.02	1.25	1.38	2.75	4.50	1.80	1.02	.90	.82	.90	.75
27	.65	1.20	1.45	1.38	2.65	4.35	1.75	1.02	.90	.80	.75	.75
28	.65	1.18	1.48	1.45	2.55	4.28	1.72	1.10	1.00	.80	.88	.68
29	.65	.....	1.35	1.48	2.85	4.08	1.65	1.10	.95	.80	.88	.68
30	.65	.....	1.18	1.50	2.90	3.85	1.65	1.10	.95	.80	.85	.68
31	.65	.....	1.35	.....	3.00	.....	1.60	1.10	.....	.80	.....	.65
1908.												
1	.70	.65	.65	.75	.75	8.30	2.60	1.15	.95	.85	1.00	.92
2	.70	.65	.65	.75	.75	6.60	2.45	1.12	.92	.95	1.00	.80
3	.70	.65	.65	.80	.75	6.40	2.30	1.10	.88	.98	1.00	.82
4	.70	.65	.60	.75	.80	6.95	2.22	1.08	.88	.98	1.00	.82
5	.70	.65	.60	.80	.78	9.50	2.15	1.08	.85	.95	1.00	.85
6	.70	.70	.65	.78	.75	8.30	2.12	1.05	.80	.95	1.00	.92
7	.75	.70	.70	.80	.80	8.45	2.10	1.05	.80	.92	1.00	1.00
8	.75	.65	.70	.78	.75	7.85	2.00	1.15	.80	.92	1.00	1.00
9	.75	.65	.70	.75	.85	7.32	1.85	1.15	.80	.90	1.00	.95
10	.75	.60	.80	.75	1.15	6.70	1.80	1.12	.80	.90	.98	.92
11	.72	.60	.90	.75	1.05	6.20	1.78	1.10	.80	.90	.98	.90
12	.72	.60	.80	.80	1.35	5.80	1.72	1.12	.80	.90	.98	.95
13	.70	.60	.85	.75	1.28	5.38	1.70	1.30	.78	.90	.98	.78
14	.70	.60	.92	.75	1.40	4.85	1.90	1.28	.78	.90	.95	.80
15	.65	.60	.90	.70	1.35	4.62	2.20	1.22	.78	.92	.92	.85
16	.65	.65	1.10	.75	1.65	4.50	1.90	1.22	.78	1.00	1.00	.75
17	.65	.65	1.00	.75	1.55	4.32	1.85	1.20	.95	1.00	1.15	.75
18	.65	.65	1.00	.75	1.40	4.10	1.80	1.20	1.00	1.00	1.12	.80
19	.70	.65	1.00	.75	1.82	3.95	1.75	1.20	.90	1.00	1.12	.82
20	.70	.65	1.02	.80	1.55	3.70	1.70	1.18	.88	1.05	1.00	.82
21	.65	.65	.95	.75	1.62	3.50	1.65	1.18	.85	1.05	1.00	.82
22	.65	.70	.80	.75	1.75	3.40	1.60	1.18	.82	1.05	1.00	.82
23	.65	.80	.80	.70	1.60	3.28	1.58	1.15	.80	1.05	1.00	.82
24	.65	.80	.68	.78	1.60	3.00	1.52	1.12	.85	1.05	1.00	.82
25	.65	.80	.85	.72	1.85	2.90	1.50	1.10	.90	1.05	1.00	.88
26	.65	.75	.80	.70	1.85	2.80	1.48	1.10	.90	1.05	1.00	.88
27	.65	.75	.80	.70	3.50	2.75	1.45	1.10	.90	1.02	.95	.90
28	.70	.65	.80	.70	2.68	2.72	1.40	1.10	.90	1.02	.95	.90
29	.65	.65	.80	.72	2.48	2.68	1.38	1.00	.88	1.00	.92	.90
30	.65	.....	.80	.75	3.10	2.60	1.30	1.00	.85	1.00	.92	.88
31	.65	.....	.75	.....	4.60	.....	1.20	1.00	.....	1.00	.....	.88

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Rating tables for Willow Creek near Augusta, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	6	1.70	41	2.80	89	3.90	144
.70	8	1.80	45	2.90	94	4.00	149
.80	10	1.90	49	3.00	99	4.20	159
.90	13	2.00	53	3.10	104	4.40	169
1.00	16	2.10	57	3.20	109	4.60	179
1.10	19	2.20	61	3.30	114	4.80	191
1.20	22	2.30	65	3.40	119	5.00	203
1.30	25	2.40	69	3.50	124	5.20	215
1.40	29	2.50	74	3.60	129	5.40	227
1.50	33	2.60	79	3.70	134		
1.60	37	2.70	84	3.80	139		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on discharge measurements made during 1905–1907 and is well defined.

FOR 1908.

0.60	5	2.00	53	3.40	123	5.60	261
.70	7	2.10	58	3.50	128	5.80	275
.80	10	2.20	63	3.60	134	6.00	289
.90	12	2.30	68	3.70	140	6.20	303
1.00	15	2.40	73	3.80	146	6.40	317
1.10	18	2.50	78	3.90	152	6.60	332
1.20	21	2.60	83	4.00	158	6.80	348
1.30	25	2.70	88	4.20	170	7.00	364
1.40	29	2.80	93	4.40	182	8.00	444
1.50	33	2.90	98	4.60	194	9.00	524
1.60	37	3.00	103	4.80	206	10.00	604
1.70	41	3.10	108	5.00	219		
1.80	45	3.20	113	5.20	233		
1.90	49	3.30	118	5.40	247		

NOTE.—The above table is not applicable for obstructed-channel conditions. It is based on discharge measurements made in 1906–1908 and is fairly well defined below gage height 3.5 feet. Above gage height 4.5 feet the rating curve is a tangent, the difference being 8 per tenth.

Monthly discharge of Willow Creek near Augusta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
January	8	6	7.0	430	D.
February	260	6	44.5	2,470	A.
March	39	17	25.3	1,560	A
April	33	23	27.7	1,650	A.
May	99	33	65.1	4,000	A.
June	227	52	111	6,600	A.
July	134	37	71.9	4,420	A.
August	37	17	24.2	1,490	A.
September	19	13	16.0	952	A.
October	17	10	11.8	726	C.
November	14	8	11.0	655	C.
December	14	6	9.8	602	D.
The year	260	6	35.4	25,600	

31260—IRR 246—10——5

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Monthly discharge of Willow Creek near Augusta, Mont., for 1907 and 1908—Cont'd.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
January	8	6	.6.74	414	D.
February	10	5	6.45	371	D.
March	18	5	10.1	621	D.
April	10	7	8.27	492	D.
May	194	8	40.3	2,480	A.
June	564	83	240	14,300	B.
July	83	21	45.9	2,820	A.
August	25	15	19.1	1,170	A.
September	15	9	11.1	660	A.
October	16	11	14.2	873	B.
November	20	13	15.0	893	B.
December	15	8	11.3	695	B.
The year	594	5	35.7	25,800	

FORD CREEK NEAR AUGUSTA, MONT.

This station, which is located at the ranch of Joseph Ford, 16 miles west of Augusta, was established April 11, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

Ford Creek is a branch of Willow Creek and has no important tributaries. One small irrigation ditch diverts water from the creek above the gage.

The current is swift and the gage heights are but little affected by ice. Conditions of flow are changeable, requiring frequent measurements to properly define the rating curve. The gage datum has remained unchanged.

Discharge measurements of Ford Creek near Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	Follansbee and Stewart	15	11.1	1.35	29.1
May 25	J. E. Stewart	20	22.2	1.82	87.0
June 13	do	26	28.8	1.89	91.0
August 2	do	14	16.6	1.40	34.1
September 19	Follansbee and Stewart	12	14.2	1.02	18.2
1908.					
May 5	Raymond Richards	12	8.3	1.11	23.9
May 28	do	24	23.9	1.68	68.0
June 19	J. E. Stewart	23	36.0	1.90	102
July 12	Raymond Richards	13	13.6	1.30	47.1
August 28	do	12	8.4	.91	21.5
October 15	do	12	9.2	.97	24.2

NOTE.—These measurements were made by wading at various sections.

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Daily gage height, in feet, of Ford Creek near Augusta, Mont., for 1907 and 1908.

[Joseph Ford, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	1.10	1.10	1.20	2.10	2.20	1.40	1.10	1.05	0.95	0.90
2	.....	.....	1.00	1.10	1.30	2.00	2.18	1.40	1.10	1.05	.95	.90
3	.....	.....	1.00	1.10	1.25	2.02	2.10	1.40	1.10	1.05	.95	.90
4	.....	.....	1.00	1.10	1.20	2.00	2.00	1.40	1.10	1.05	.90	.90
5	.....	1.10	1.00	1.10	1.25	2.00	2.00	1.40	1.10	1.05	.90	.90
6	.....	1.10	1.00	1.10	1.30	2.00	1.90	1.40	1.10	1.05	.90	.90
7	.....	1.10	1.00	1.10	1.40	2.00	1.80	1.35	1.10	1.05	.90	.90
8	.....	1.10	1.00	1.10	1.60	2.00	1.80	1.35	1.10	1.05	.90	.90
9	.....	1.20	1.00	1.15	1.80	2.00	1.85	1.30	1.10	1.05	.90	.90
10	.....	1.20	1.00	1.20	1.78	2.00	1.80	1.30	1.10	1.05	.90	.90
11	.....	1.10	1.00	1.30	1.70	1.92	1.72	1.30	1.10	1.05	.90	.90
12	.....	1.10	1.00	1.35	1.70	1.90	1.70	1.25	1.10	1.05	.90	.90
13	.....	1.10	1.10	1.40	1.70	1.88	1.65	1.20	1.05	1.05	.90	.90
14	.....	1.10	1.00	1.40	1.70	1.80	1.65	1.10	1.05	1.05	.90	.90
15	.....	1.10	1.00	1.40	1.72	1.80	1.65	1.10	1.05	1.05	.90	.90
16	.....	1.10	1.00	1.40	1.85	1.80	1.60	1.10	1.05	1.05	.90	.90
17	.....	1.00	1.00	1.40	1.85	1.80	1.60	1.10	1.05	1.05	.90	.90
18	.....	1.00	1.10	1.35	1.85	1.80	1.60	1.10	1.05	1.05	.90	.90
19	.....	1.00	1.20	1.35	1.95	1.80	1.60	1.10	1.05	1.00	.90	.90
20	1.10	1.00	1.20	1.30	1.95	1.95	1.60	1.10	1.05	1.00	.90	.90
21	1.10	1.00	1.20	1.30	1.85	2.00	1.58	1.10	1.05	1.00	.90	.90
22	1.00	1.00	1.20	1.30	1.85	2.15	1.52	1.10	1.05	1.00	.90	.90
23	1.00	1.00	1.20	1.30	1.80	3.50	1.50	1.10	1.05	1.00	.90	.90
24	.....	1.00	1.20	1.20	1.80	3.25	1.50	1.10	1.05	1.00	.90	.90
25	.....	1.00	1.20	1.20	1.80	2.90	1.48	1.10	1.05	1.00	.90	.90
26	.....	1.00	1.15	1.20	1.80	2.60	1.45	1.10	1.05	1.00	.90	.90
27	.....	1.10	1.10	1.20	1.85	2.48	1.45	1.10	1.05	1.00	.90	.90
28	.....	1.10	1.10	1.40	1.85	2.32	1.45	1.10	1.05	1.00	.90	.90
29	.....	.....	1.10	1.20	1.92	2.25	1.45	1.10	1.05	1.00	.90	.90
30	.....	.....	1.10	1.20	2.05	2.20	1.40	1.10	1.05	.98	.90	.90
31	.....	.....	1.00	.....	2.10	.....	1.35	1.10	.....	.95	.....	.90
1908.												
1	.90	2.00	.70	.70	1.10	3.90	1.50	1.15	.90	.90	.90	.90
2	.90	2.00	.70	.70	1.10	3.60	1.50	1.12	.90	.90	.90	.90
3	.90	2.00	1.10	.70	1.10	3.35	1.40	1.10	.90	.90	.90	.90
4	.90	2.00	1.10	.70	1.10	3.65	1.40	1.05	.90	.90	.90	.90
5	.90	2.00	1.10	.70	1.10	4.40	1.40	1.00	.90	.90	.90	.90
6	.90	.90	.98	.70	1.10	3.80	1.40	1.00	.90	.90	.90	.90
7	.90	.90	.80	.80	1.10	3.75	1.40	1.00	.90	.90	.90	.88
8	.90	.90	.70	.80	1.10	3.55	1.35	1.00	.90	.90	.90	.82
9	.90	.90	.70	.80	1.10	3.10	1.30	1.00	.90	.90	.90	.80
10	.90	.90	.70	.80	1.15	2.70	1.30	1.00	.90	.90	.90	.80
11	.90	.90	.70	.90	1.28	2.45	1.30	1.00	.90	.90	1.05	.80
12	.90	.90	.70	.90	1.38	2.38	1.30	1.00	.90	.90	1.10	.80
13	.90	.90	.70	.90	1.40	2.32	1.30	1.00	.90	.90	.95	.80
14	.90	.90	.80	.90	1.40	2.25	1.30	1.00	.90	.90	.90	.80
15	.90	.90	.70	.90	1.60	2.20	1.30	1.00	.90	.90	.90	.80
16	.90	.90	.70	.95	1.60	2.18	1.30	1.00	.90	.90	.90	.80
17	.90	.85	.70	1.00	1.60	2.10	1.22	1.00	.90	.90	.90	.80
18	.90	.80	.70	1.00	1.60	2.05	1.20	1.00	.90	.90	.90	.80
19	.90	.80	.70	1.00	1.60	1.90	1.20	1.00	.90	.90	.90	.80
20	.90	.80	.70	1.12	1.60	1.80	1.20	1.00	.90	.90	.90	.80
21	.90	.80	.70	1.10	1.60	1.80	1.20	1.00	.90	.90	.90	.80
22	.90	.80	.70	1.10	1.60	1.80	1.20	1.00	.90	.90	.90	.80
23	.90	.80	.70	1.10	1.60	1.78	1.20	1.00	.90	.90	.90	.80
24	.90	.80	.70	1.10	1.58	1.70	1.20	1.00	.90	.90	.90	.80
25	.90	.80	.70	1.10	1.55	1.70	1.20	1.00	.90	.90	.90	.80
26	.90	.70	1.10	1.10	1.70	1.60	1.20	.95	.90	.90	.90	.80
27	.90	.70	.70	1.05	1.70	1.60	1.20	.95	.90	.90	.90	.80
28	.90	.70	.70	1.05	1.70	1.52	1.20	.90	.90	.90	.90	.80
29	.90	.70	.70	1.05	1.70	1.50	1.20	.90	.90	.90	.90	.95
30	1.10	.....	.70	1.10	1.75	1.50	1.15	.90	.90	.90	.90	1.60
31	1.30	.....	1.10	.....	2.48	.....	1.15	.90	.....	.90	.....	1.60

NOTE.—Ice conditions January 1–February 4, 1907; April 28, 1907, slight ice gorge due to slush ice; January 30–February 5, March 3–7, 26, and 30, 1908; also November 11–13 and December 29–31, 1908.

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Rating tables for Ford Creek near Augusta, Mont.

JANUARY 1 TO AUGUST 2, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	10	1.70	67	2.40	185	3.20	355
1.10	14	1.80	81	2.50	205	3.40	405
1.20	19	1.90	96	2.60	225	3.60	460
1.30	26	2.00	112	2.70	245	3.80	520
1.40	34	2.10	129	2.80	265	4.00	580
1.50	43	2.20	147	2.90	285	4.20	650
1.60	54	2.30	166	3.00	305	4.40	720

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1907 and the form of the 1906 curve. It is fairly well defined between gage heights 1.3 feet and 2.0 feet.

SEPTEMBER 19 TO JUNE 18, 1908.

0.90	12	1.20	29	1.50	51	1.80	82
1.00	17	1.30	36	1.60	60	1.90	96
1.10	23	1.40	43	1.70	70	2.00	112

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is fairly well defined between gage heights 0.9 foot and 2.0 feet. Above gage height 2.0 feet use the preceding curve.

JUNE 19 TO DECEMBER 31, 1908.

0.80	16	1.10	32	1.40	52	1.70	79
0.90	21	1.20	38	1.50	60	1.80	90
1.00	26	1.30	45	1.60	69	1.90	102

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during the above period and is fairly well defined.

Monthly discharge of Ford Creek near Augusta, Mont., for 1907 and 1908.

[Drainage area, 18 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	.....	.....	10.0	0.556	0.64	615	D.
February	19	10	12.6	.700	.73	700	C.
March	19	10	13.1	.728	.84	806	B.
April	34	14	22.3	1.24	1.38	1,330	B.
May	129	19	71.4	3.97	4.58	4,390	A.
June	430	81	142	7.89	8.80	8,450	A.
July	147	30	67.6	3.76	4.34	4,160	A.
August	34	20	24.0	1.33	1.53	1,480	B.
September	22	20	20.4	1.13	1.26	1,210	B.
October	20	12.5	18.6	1.03	1.19	1,140	B.
November	12.5	12	12.0	.667	.74	714	C.
December	12	12	12.0	.667	.77	738	D.
The year	430	.....	35.5	1.97	26.80	25.700	

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Monthly discharge of Ford Creek near Augusta, Mont., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
January	12	12	12.0	0.667	0.77	738	D.
February	12	5.3	6.59	.366	.39	379	D.
March	8.5	.....	5.34	.297	.34	328	D.
April	24	5.3	14.5	.806	.90	863	C.
May	201	23	51.8	2.88	3.32	3,190	B.
June	720	60	227	12.6	14.06	13,500	B.
July	60	35	43.7	2.43	2.80	2,690	B.
August	35	21	26.0	1.44	1.66	1,600	B.
September	21	21	21.0	1.17	1.30	1,250	B.
October	21	21	21.0	1.17	1.35	1,290	B.
November	21	21	21.0	1.17	1.30	1,250	C.
December	21	16	17.1	.950	1.10	1,050	D.
The year	720	.....	38.9	2.16	29.29	28,100	

NOTE.—Discharge estimated August 3 to September 18, 1907, and for ice periods.

SMITH CREEK NEAR AUGUSTA, MONT.

This station, which is located 1 mile above J. W. Nixon's ranch, 16 miles southwest of Augusta, Mont., was established April 14, 1906, to obtain run-off data for use in connection with the Sun River irrigation project.

The ordinary summer flow is practically all used for irrigation, but no water is diverted above the gaging station.

Measurements can be made only by wading and conditions for obtaining accurate discharge data are good at low and medium stages; no measurements can be made at flood stages. Gage heights are not affected by ice. The gage datum has not been changed since the station was established. The discharge curves plotted for this station are shown in figure 1, page 23.

Discharge measurements of Smith Creek near Augusta, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		Feet.	Sq. ft.	Feet.	Sec.-ft.
April [illegible]	Fullerton and Stewart	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	J. E. Stewart	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
August [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
September 20	Fullerton and Stewart	[illegible]	[illegible]	[illegible]	[illegible]
1908.					
May [illegible]	Stewart and Richards	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	Fullerton and Stewart	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	J. E. Stewart	[illegible]	[illegible]	[illegible]	[illegible]
July [illegible]	Fullerton and Stewart	[illegible]	[illegible]	[illegible]	[illegible]
August 3	do	[illegible]	[illegible]	[illegible]	[illegible]
September 20	do	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]—These measurements were made by wading at various sections.

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Daily gage height, in feet, of Smith Creek near Augusta, Mont., for 1907 and 1908.

[Mrs. J. W. Nixon, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	0.95	0.95	0.95	1.05	1.2	1.75	1.7	1.2	1.1	1.0	1.0	1.0
2	.95	.95	.95	1.05	1.2	1.7	1.65	1.2	1.1	1.0	1.0	1.0
3	.95	1.0	.9	1.1	1.2	1.7	1.6	1.2	1.1	1.0	1.0	1.0
4	.95	1.0	.9	1.2	1.1	1.6	1.6	1.2	1.1	1.0	1.0	1.0
5	.9	1.0	.9	1.2	1.1	1.6	1.5	1.2	1.1	1.0	1.0	1.0
6	.9	1.0	.9	1.2	1.2	1.6	1.5	1.15	1.1	1.0	1.0	1.0
7	.9	1.05	.9	1.2	1.2	1.6	1.5	1.15	1.1	1.0	1.0	1.0
8	.9	1.05	.9	1.2	1.25	1.65	1.5	1.15	1.1	1.0	1.0	1.0
9	.9	1.05	.9	1.2	1.25	1.5	1.5	1.1	1.1	1.0	1.0	1.0
10	.9	1.0	.9	1.2	1.45	1.5	1.5	1.1	1.1	1.0	1.0	1.0
11	.9	1.0	.9	1.2	1.6	1.5	1.4	1.1	1.1	1.0	1.0	1.0
12	.9	.9	.9	1.2	1.45	1.55	1.4	1.1	1.05	1.0	1.0	1.0
13	.9	.9	.9	1.2	1.45	1.4	1.4	1.1	1.05	1.0	1.0	1.0
14	.9	.9	.9	1.15	1.45	1.4	1.3	1.1	1.05	1.0	1.0	1.0
15	.9	.9	.9	1.15	1.35	1.45	1.3	1.1	1.05	1.0	1.0	1.0
16	.9	.9	.9	1.15	1.3	1.4	1.3	1.1	1.05	1.0	1.0	1.0
17	.9	.9	1.0	1.15	1.38	1.35	1.3	1.1	1.05	1.0	1.0	1.0
18	.9	.9	1.1	1.15	1.45	1.3	1.3	1.1	1.05	1.0	1.0	1.0
19	.9	.9	1.1	1.15	1.4	1.3	1.3	1.1	1.05	1.0	1.0	1.0
20	.95	.9	1.1	1.15	1.8	1.3	1.3	1.1	1.05	1.0	1.0	1.0
21	.95	.9	1.1	1.1	1.7	1.4	1.3	1.1	1.05	1.0	1.0	1.0
22	.95	.9	1.1	1.1	1.7	2.2	1.3	1.1	1.05	1.0	1.0	1.0
23	.95	.9	1.1	1.2	1.6	3.7	1.3	1.1	1.05	1.0	1.0	1.0
24	.95	.9	1.05	1.2	1.5	2.8	1.3	1.1	1.05	1.0	1.0	1.0
25	.95	.9	1.05	1.15	1.5	2.15	1.3	1.1	1.05	1.0	1.0	1.0
26	.9	.9	1.0	1.15	1.6	2.2	1.3	1.1	1.05	1.0	1.0	1.0
27	.9	.95	1.0	1.2	1.6	2.2	1.3	1.1	1.05	1.0	1.0	1.0
28	.9	.95	1.0	1.2	1.6	2.1	1.2	1.1	1.05	1.0	1.0	1.0
29	.9	.....	1.0	1.2	1.7	1.9	1.2	1.1	1.05	1.0	1.0	1.0
30	.9	.....	1.05	1.2	1.75	1.9	1.2	1.1	1.05	1.0	1.0	1.0
31	.9	.....	1.05	.....	1.8	.....	1.2	1.1	.....	1.0	.....	1.0
1908.												
1	1.0	1.0	1.0	1.0	1.1	3.25	.9	.65	.6	.6	.75	.7
2	1.0	1.0	1.0	1.0	1.1	2.3	.9	.6	.6	.65	.75	.7
3	1.0	1.0	1.0	1.0	1.1	3.6	.85	.6	.6	.65	.75	.7
4	1.0	1.0	1.0	1.0	1.1	3.0	.8	.6	.6	.65	.75	.7
5	1.0	1.0	1.0	1.0	1.1	3.65	.8	.6	.6	.70	.75	.7
6	1.0	1.0	1.0	1.0	1.1	2.8	.8	.6	.6	.75	.75	.7
7	1.0	1.0	1.0	1.0	1.1	2.5	.8	.6	.6	.75	.75	.7
8	1.0	1.0	1.0	1.0	1.1	2.4	.8	.6	.6	.75	.75	.7
9	1.0	1.0	1.0	1.0	1.2	2.0	.8	.6	.6	.8	.75	.7
10	1.0	1.0	1.0	1.0	1.4	1.8	.8	.6	.55	.8	.75	.7
11	1.0	1.0	1.0	1.0	1.5	1.7	.8	.6	.55	.85	.75	.65
12	1.0	1.0	1.0	1.0	1.5	1.6	.8	.65	.55	.9	.75	.65
13	1.0	1.0	1.05	1.0	1.5	1.5	.8	.65	.55	.9	.75	.6
14	1.0	1.0	1.05	1.0	1.5	1.3	.8	.7	.55	1.0	.75	.6
15	1.0	1.0	1.06	1.0	1.6	1.2	.8	.75	.55	1.0	.7	.6
16	1.0	1.0	1.0	1.0	1.6	1.2	.8	.7	.55	1.0	.7	.6
17	1.0	1.0	1.0	1.0	1.55	1.1	.8	.65	.6	1.0	.7	.6
18	1.0	1.0	1.0	1.0	1.5	1.1	.8	.65	.65	1.0	.7	.6
19	1.0	1.0	1.0	1.1	1.5	1.1	.75	.6	.7	1.0	.7	.6
20	1.0	1.0	1.0	1.1	1.6	1.1	.75	.6	.7	.95	.7	.6
21	1.0	1.0	1.0	1.1	1.6	1.05	.75	.6	.65	.9	.7	.6
22	1.0	1.0	1.0	1.1	1.6	1.05	.75	.6	.65	.8	.7	.6
23	1.0	1.0	1.0	1.1	1.6	1.0	.75	.6	.6	.8	.7	.6
24	1.0	1.0	1.0	1.1	1.6	1.0	.75	.6	.6	.8	.7	.6
25	1.0	1.0	1.0	1.1	1.7	1.0	.75	.6	.6	.8	.7	.6
26	1.0	1.0	1.0	1.1	1.75	1.0	.7	.6	.6	.8	.7	.6
27	1.0	1.0	1.0	1.1	1.8	1.0	.7	.6	.6	.8	.7	.6
28	1.0	1.0	1.0	1.1	1.8	1.0	.7	.6	.6	.8	.7	.6
29	1.0	1.0	1.0	1.1	1.8	1.0	.65	.6	.6	.75	.7	.6
30	1.0	.....	1.0	1.1	1.9	1.0	.65	.6	.6	.75	.7	.6
31	1.0	.....	1.0	.....	2.75	.....	.65	.6	.....	.75	.....	.6

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Rating tables for Smith Creek near Augusta, Mont.

APRIL 16, 1906, TO JUNE 23, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	6	1.60	123	2.40	354	3.20	631
.90	12	1.70	148	2.50	387	3.30	666
1.00	20	1.80	175	2.60	421	3.40	701
1.10	31	1.90	203	2.70	456	3.50	736
1.20	45	2.00	232	2.80	491	3.60	771
1.30	61	2.10	261	2.90	526	3.70	806
1.40	79	2.20	291	3.00	561		
1.50	100	2.30	322	3.10	596		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eleven discharge measurements made during the above period, and is well defined between gage heights 0.9 foot and 1.6 feet.

JUNE 24, 1907, TO JUNE 5, 1908.

1.00	13	1.70	132	2.40	335	3.20	613
1.10	21	1.80	158	2.50	368	3.40	687
1.20	32	1.90	185	2.60	402	3.60	761
1.30	47	2.00	213	2.70	436	3.80	835
1.40	64	2.10	242	2.80	470		
1.50	84	2.20	272	2.90	505		
1.60	107	2.30	303	3.00	540		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during the above period and the form of the previous curve, and is well defined between gage heights 1.0 foot and 1.9 feet.

JUNE 6, 1908, TO OCTOBER 13, 1908.

0.60	17	1.20	107	1.80	242	2.40	404
.70	28	1.30	127	1.90	268	2.50	432
.80	40	1.40	148	2.00	295	2.60	460
.90	54	1.50	170	2.10	322	2.70	488
1.00	70	1.60	193	2.20	349	2.80	517
1.10	88	1.70	217	2.30	376		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period, and is well defined below gage height 1.3 feet.

OCTOBER 14, 1908, TO DECEMBER 31, 1908.

0.60	12	0.80	30	0.90	42	1.00	57
.70	20						

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on one discharge measurement made during the above period and the shape of the previous curve, and is not well defined.

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Monthly discharge of Smith Creek near Augusta, Mont., for 1907 and 1908.

[Drainage area, 26 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	16	12	13.3	0.512	0.59	818	B.
February	25	12	15.7	.604	.63	872	B.
March	31	12	18.9	.727	.84	1,160	B.
April	45	25	40.2	1.55	1.73	2,390	A.
May	175	31	93.3	3.59	4.14	5,740	A.
June	806	61	171	6.58	7.34	10,200	B.
July	132	32	62.8	2.42	2.79	3,860	B.
August	32	21	23.3	.896	1.03	1,430	C.
September	21	17	18.5	.712	.79	1,100	C.
October	13	13	13.0	.500	.58	799	D.
November	13	13	13.0	.500	.56	774	D.
December	13	13	13.0	.500	.58	799	D.
The year	806	12	41.3	1.59	21.60	29,900	
1908.							
January	13	13	13.0	.500	.58	799	D.
February	13	13	13.0	.500	.54	748	D.
March	17	13	13.4	.515	.59	824	D.
April	21	13	16.2	.623	.70	964	C.
May	453	21	96.8	3.72	4.29	5,950	A.
June	780	70	230	8.85	9.87	13,700	A.
July	54	22	36.9	1.42	1.64	2,270	B.
August	34	17	19.1	.735	85	1,170	C.
September	28	14	17.5	.673	.75	1,040	C.
October	57	17	37.6	1.45	1.67	2,310	B.
November	25	20	22.3	.858	.96	1,330	C.
December	20	12	15.0	.577	.67	922	D.
The year	780	12	44.2	1.70	23.11	32,000	

MARIAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The headwaters of Marias River rise on the eastern slope of the main divide of the Rocky Mountains at an elevation of over 8,000 feet and flow in an easterly direction through a region of elevated plains and prairies. Marias River proper is formed by the union of Cutbank and Two Medicine rivers, which meet at the eastern boundary of the Blackfeet Indian Reservation. From this junction to the Missouri, which it enters 14 miles below Fort Benton, its length is about 110 miles and its fall does not exceed 5 feet per mile. Its principal tributaries are Willow and Cottonwood creeks, which enter from the north, and Teton River, which comes in from the south.

The general altitude of this country is from 3,000 to 4,000 feet, the plains rising by gentle terraces toward the mountains to elevations of about 5,000 feet. Grass is abundant and the region is devoted to grazing. Considerable spruce and pine timber is found at the headwaters in the mountains, but the remainder of the basin is bare except fringes and small groves along the streams.

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The mean annual rainfall varies from about 60 inches in the mountains to 12 inches near the mouth of the river, the average for the plains section being about 16 inches. The streams are icebound from December until early in March, and this is the season of least flow.

Irrigation has been practiced to a slight extent for a number of years in the valleys of the tributaries, and three large irrigation projects are now under construction. One is being constructed by the United States Reclamation Service, and the other two under the Carey Act. Altogether about 450,000 acres will be reclaimed. The basin affords a number of excellent reservoir sites, which will be utilized in storing the flood waters of the upper tributaries from which the principal water supply for these projects will come.

The great fall and the abundant water supply of the upper tributaries of Marias River also afford favorable conditions for water-power development.

Run-off records in this basin extend back to 1902. The wettest year since that time was 1903, and the driest was 1905.

The following gaging stations have been maintained in this river basin:

Cutbank Creek at Cutbank, Mont., 1905–1908.
Marias River near Shelby, Mont., 1902–1907.
Two Medicine Creek near Midvale, Mont., 1902–3.
Two Medicine Creek at Family, Mont., 1907–8.
Badger Creek near Family, Mont., 1907–8.
Birch Creek near Dupuyer, Mont., 1907–8.
Dupuyer Creek at Dupuyer, Mont., 1908.
Teton River at Chouteau, Mont., 1905–6.
Teton River near Belleview, Mont., 1905–6 and 1908.

CUTBANK CREEK AT CUTBANK, MONT.

This station, which is located one-half mile southwest of Cutbank, one-fourth mile below the Great Northern Railway bridge, and 12 miles above the mouth of Two Medicine, was established August 4, 1905, to obtain data for use in connection with irrigation projects under consideration by the United States Reclamation Service.

The intake of the Great Northern Railway's pumping station is located a hundred yards above the gage. The average quantity pumped is about 14,000 gallons an hour for eighteen hours a day—equivalent to a continuous flow of 0.4 second-foot.

The datum of the gage has not been changed since the station was established. The records during the winter months are somewhat affected by ice. The results taken as a whole can be considered as good.

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Discharge measurements of Cutbank Creek at Cutbank, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 9	J. B. Pierson	65	78	3.51	349
May 21	J. E. Stewart	110	164	4.02	754
June 12	J. B. Pierson	110	175	4.04	798
June 27	Follansbee and Pierson	125	235	4.29	1,020
July 13	J. B. Pierson	108	150	3.85	631
July 26	do	101	102	3.56	369
August 6	do	90	75	3.39	234
August 21 [a]	Follansbee and Pierson	80	45.7	3.17	107
October 17	J. E. Stewart	60	35.8	3.05	77.0
1908.					
April 21	A. F. Huch	106	120	3.69	423
May 21	do	105	109	3.72	390
June 21	do	133	221	3.89	755
August 6 [a]	Stewart and Huch	100	70	3.07	129
August 20 [a]	J. E. Stewart	64	57.4	2.91	69.9

[a] Made by wading.

Daily gage height, in feet, of Cutbank Creek at Cutbank, Mont., for 1907 and 1908.

[Frank Mason and Conrad Peters, observers.]

Day	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907												
1	.....	.....	4.2	4.4	4.3	4.16	4.25	4.4	4.4	4.2	4.0	2.9
2	.....	.....	4.1	4.1	4.3	4.2	4.1	4.4	4.3	4.2	4.1	3.0
3	4.2	.....	...	4.7	4.3	4.4	4.1	4.4	4.3	4.3	2.9	2.9
4	.....	.....	...	4.3	4.3	4.25	4.15	4.3	4.2	4.2	2.9	2.9
5	.....	.....	.....	4.5	4.3	4.1	4.1	4.3	4.3	4.1	3.0	3.1
6	.....	.....	.....	4.15	4.16	4.2	4.16	4.4	4.2	4.2	2.9	3.05
7	.....	4.3	4.4	4.2	4.16	4.3	4.1	4.15	4.3	4.1	2.9	3.1
8	.....	.....	.....	4.2	4.2	4.3	4.4	4.3	4.2	4.1	3.0	.....
9	.....	.....	.....	4.2	4.2	4.4	4.4	4.3	4.3	4.2	2.9	.....
10	4.1	.....	.....	4.2	4.2	4.25	4.3	4.3	4.2	4.1	2.9	.....
11	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
12	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
13	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
14	.....	4.2	4.2	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
15	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
16	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
17	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
18	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
19	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
20	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
21	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
22	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
23	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
24	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
25	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
26	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
27	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
28	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
29	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
30	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
31	.....	4.2	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	.....
1908												
1	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.2
2	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.2
3	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.25
4	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.3
5	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.4
6	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.4
7	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.4
8	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.4
9	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.5
10	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.5
11	.....	.....	.....	4.2	4.2	4.2	4.3	4.3	4.3	4.1	3.0	3.5

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Daily gage height in feet, of Cutbank Creek at Cutbank, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
11	.....	.....	.....	3.25	3.8	4.7	3.5	3.0	2.8	3.0	3.0	3.5
12	.....	.....	.....	3.3	3.9	4.6	3.5	3.0	2.8	3.0	3.0	3.5
13	.....	.....	.....	3.35	4.1	4.5	3.5	3.0	2.8	3.0	3.0	3.5
14	.....	.....	.....	3.4	4.0	4.35	3.5	3.1	2.8	3.0	3.0	3.5
15	.....	.....	.....	3.5	4.1	4.25	3.5	3.1	2.8	3.0	3.1	3.5
16	.....	.....	.....	3.4	4.2	4.15	3.5	3.1	2.8	3.0	3.15	3.4
17	.....	.....	.....	3.4	4.05	4.15	3.5	3.1	2.9	3.0	3.2	3.4
18	.....	.....	.....	3.4	3.9	4.1	3.5	3.0	3.0	3.0	3.2	3.5
19	.....	.....	.....	3.5	3.8	4.0	3.5	3.0	3.0	3.0	3.2	3.5
20	.....	.....	.....	3.6	3.8	4.0	3.4	3.0	3.0	3.1	3.2	3.5
21	.....	.....	.....	3.7	3.75	3.95	3.4	3.1	2.9	3.1	3.2	3.5
22	.....	.....	.....	3.8	3.7	3.8	3.4	3.1	2.9	3.0	3.2	3.6
23	.....	.....	.....	3.8	3.7	3.8	3.4	3.1	2.9	3.0	3.2	3.6
24	.....	.....	.....	3.8	3.7	3.7	3.4	3.1	2.9	3.0	3.2	3.6
25	.....	.....	.....	3.8	3.75	3.7	3.3	3.0	3.0	3.0	3.1	3.6
26	.....	.....	.....	3.7	3.9	3.7	3.3	3.0	3.0	3.0	3.1	3.5
27	.....	.....	.....	3.65	3.9	3.7	3.3	3.0	3.0	3.0	3.1	3.6
28	.....	.....	.....	3.6	3.9	3.7	3.2	3.0	3.05	3.0	3.2	3.6
29	.....	.....	.....	3.6	3.9	3.65	3.2	2.95	3.1	3.0	3.25	3.7
30	.....	.....	.....	3.55	3.8	3.6	3.2	2.9	3.1	3.0	3.2	3.7
31	.....	.....	.....	.....	3.95	.....	3.2	2.9	.....	3.0	.....	3.6

NOTE.—Creek frozen entirely across January 1 to February 11, 1907. March 3-21, 1907, it was full of anchor ice. Ice conditions December 8, 1907, to March 31, 1908, and December, 1908.

Rating tables for Cutbank Creek at Cutbank, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	60	4.00	750	5.00	1,780	6.00	3,020
3.10	84	4.10	845	5.10	1,890	6.20	3,300
3.20	125	4.20	940	5.20	2,010	6.40	3,580
3.30	180	4.30	1,040	5.30	2,130	6.60	3,860
3.40	248	4.40	1,140	5.40	2,250	6.80	4,140
3.50	322	4.50	1,240	5.50	2,370	7.00	4,420
3.60	400	4.60	1,345	5.60	2,500	7.20	4,700
3.70	483	4.70	1,450	5.70	2,630		
3.80	569	4.80	1,560	5.80	2,760		
3.90	658	4.90	1,670	5.90	2,890		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1907 and is well defined between gage heights 3.0 feet and 4.5 feet.

APRIL 1 TO JUNE 4, 1908.

[Indirect method for shifting channels used.]

JUNE 5 TO DECEMBER 31, 1908.

2.80	45	3.70	589	4.60	1,460	6.00	3,110
2.90	65	3.80	676	4.70	1,570	6.20	3,370
3.00	94	3.90	765	4.80	1,680	6.40	3,630
3.10	138	4.00	855	4.90	1,790	6.60	3,890
3.20	197	4.10	945	5.00	1,900	6.80	4,150
3.30	264	4.20	1,040	5.20	2,140	7.00	4,410
3.40	340	4.30	1,140	5.40	2,380	8.00	5,810
3.50	420	4.40	1,240	5.60	2,620	9.00	7,310
3.60	503	4.50	1,350	5.80	2,860		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and the form of the previous curve and is not well defined.

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Daily discharge, in second-feet, of Cutbank Creek at Cutbank, Mont., for 1908.

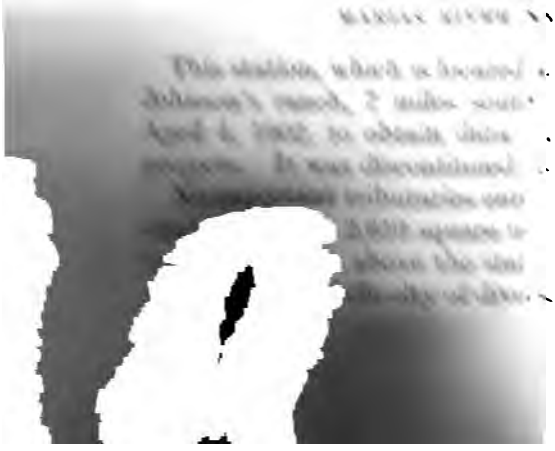
Day	Apr	May	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1	105	255	1,020	11	105	475		21	425	400	
2	151	255	2,000	12	125	560		22	520	385	
3	180	255	1,780	13	151	740		23	520	380	
4	105	320	1,000	14	180	650		24	520	375	
5	180	320		15	250	740		25	520	400	
6	214	300		16	180	815		26	420	545	
7	200	400		17	180	680		27	377	560	
8	180	485		18	180	545		28	330	560	
9	175	600		19	250	460		29	330	560	
10	105	515		20	330	460		30	290	475	
								31		605	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Cutbank Creek at Cutbank, Mont., for 1907 and 1908.

[Drainage area, 971 square miles.]

Month	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907							
January	[illegible]	[illegible]	200	0.206	0.24	12,300	D.
February	[illegible]	[illegible]	[illegible]	.710	.74	38,300	D.
March	[illegible]	[illegible]	[illegible]	.368	.31	16,000	D.
April	[illegible]	[illegible]	[illegible]	.472	.47	24,400	A.
May	[illegible]	[illegible]	[illegible]	.557	.67	34,500	A.
June	[illegible]	[illegible]	1,[illegible]	1.12	1.25	64,900	A.
July	[illegible]	[illegible]	[illegible]	.553	.64	33,000	A.
August	[illegible]	[illegible]	[illegible]	.170	.20	10,100	A.
September	[illegible]	[illegible]	[illegible]	.212	.24	12,200	A.
October	[illegible]	[illegible]	[illegible]	.082	.11	5,470	B.
November	[illegible]	[illegible]	[illegible]	.062	.07	3,490	D.
December	[illegible]	[illegible]	[illegible]	.053	.06	3,260	D.
The year	[illegible]	[illegible]	[illegible]	[illegible]	5.00	258,000	
1908							
March	[illegible]	[illegible]	[illegible]	[illegible]	.30	15,500	D.
April	[illegible]	[illegible]	[illegible]	[illegible]	.58	30,100	D.
May	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	97,000	C
June	[illegible]	[illegible]	[illegible]	[illegible]	.45	23,400	B.
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,520	B.
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,370	C.
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,330	B.
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8,390	B.
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,690	D.
The year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	199,000	



[illegible] near James A. [illegible] was established [illegible] with irrigation [illegible]. The total [illegible] taken from [illegible] banks and [illegible] canals

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receive their supply from some of the upper tributaries, especially Birch and Dupuyer creeks.

The conditions for obtaining accurate discharge data are good, except during part of the winter months, when ice exists. The gage datum has never been changed. The discharge curve is shown in figure 2, page 24.

Discharge measurements of Marias River near Shelby, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	Robert Follansbee	200	809	5.26	4,520
June 12	J. B. Pierson	200	861	5.23	4,230
June 27	Follansbee and Pierson	246	1,250	6.91	7,810
July 13	J. B. Pierson	190	721	4.74	2,910
July 27	do	170	574	4.00	1,610
August 21	Follansbee and Pierson	150	405	3.18	664
October 18	J. E. Stewart	140	350	2.79	474

Daily gage height, in feet, of Marias River near Shelby, Mont., for 1907 and 1908.

[James A. Johnson, observer.]

Day.	1907.								1908.
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
1		5.05	6.4	3.8	3.7	3.2	2.8	2.7	2.5
2		5.7	5.85	3.8	3.6	3.2	2.8	2.7	2.5
3		6.3	5.65	3.8	3.5	3.1	2.9	2.7	2.5
4		6.1	6.2	3.7	3.5	3.1	2.9	2.7	2.4
5		5.8	5.85	3.7	3.5	3.1	2.9	2.6	2.4
6		5.5	5.4	3.6	3.6	3.0	2.9	2.6	2.4
7		6.05	5.1	3.6	3.5	2.9	2.9	2.6	2.4
8		6.3	5.6	3.6	3.5	2.9	2.9	2.6	2.4
9		6.65	4.9	3.5	3.4	2.9	2.9	2.6	2.4
10		5.8	4.85	3.6	3.3	2.9	2.9	2.7	2.4
11		5.35	4.8	3.7	3.3	2.9	2.9	2.7	2.4
12		5.15	4.75	3.7	3.3	3.0	2.8	2.6	.....
13		5.3	4.7	3.6	3.2	3.0	2.8	2.6	.....
14		5.45	4.6	3.5	3.3	3.0	2.8	2.6	.....
15		5.35	4.55	3.5	3.3	2.9	2.8	2.6	.....
16		5.5	4.4	3.4	3.3	2.9	2.8	2.6	.....
17		5.1	4.3	3.5	3.3	2.8	2.8	2.6	.....
18		4.8	4.4	3.4	3.4	2.8	2.8	2.6	.....
19		4.6	4.4	3.3	3.5	2.8	2.8	2.5	.....
20	5.3	4.65	4.3	3.3	3.4	2.8	2.7	2.5	.....
21	5.4	4.9	4.3	3.2	3.4	2.8	2.7	2.5	.....
22	5.3	6.0	4.5	3.2	3.3	2.8	2.7	2.5	.....
23	5.65	12.1	4.4	3.1	3.3	2.8	2.7	2.5	
24	5.65	14.9	4.3	3.2	3.3	2.8	2.7	2.5	...
25	4.5	16.1	4.2	3.3	3.4	2.8	2.7	2.5	.....
26	4.35	7.15	4.2	3.3	3.3	2.8	2.7	2.6	.....
27	4.3	6.9	4.0	3.4	3.2	2.8	2.7	2.6	.....
28	4.35	7.4	3.95	3.4	3.2	2.8	2.8	2.5	.....
29	4.45	7.0	3.95	3.4	3.2	2.8	2.8	2.5	.....
30	4.55	6.6	3.9	3.5	3.3	2.8	2.8	2.5	.....
31	5.15	.....	3.8	3.5	.....	2.8	.....	2.5	.....

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Rating tables for Marias River near Shelby, Mont.

JUNE 27, 1907, TO JANUARY 11, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	250	3.50	1,020	4.60	2,650	5.70	4,920
2.50	290	3.60	1,130	4.70	2,840	5.80	5,140
2.60	335	3.70	1,250	4.80	3,030	5.90	5,370
2.70	385	3.80	1,370	4.90	3,230	6.00	5,600
2.80	440	3.90	1,500	5.00	3,430	6.20	6,060
2.90	500	4.00	1,640	5.10	3,630	6.40	6,520
3.00	570	4.10	1,790	5.20	3,840	6.60	7,000
3.10	640	4.20	1,950	5.30	4,050	6.80	7,480
3.20	720	4.30	2,120	5.40	4,260	7.00	7,970
3.30	810	4.40	2,290	5.50	4,480		
3.40	910	4.50	2,470	5.60	4,700		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1907, and is well defined between gage heights 2.7 feet and 8.0 feet.

MAY 20, 1907, TO JUNE 26, 1907.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Marias River near Shelby, Mont., for 1907.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1		[illegible]	11	.....	4,500	21	4,840	3,300
2		[illegible]	12	.....	4,650	22	4,580	5,700
3		[illegible]	13	.....	4,550	23	4,030	21,600
4		[illegible]	14	.....	4,700	24	4,020	29,500
5		[illegible]	15	.....	4,350	25	3,100	16,000
6		[illegible]	16	.....	4,[illegible]	26	2,610	8,340
7		[illegible]	17	.....	[illegible]	27	2,520	.....
8		[illegible]	18	.....	[illegible]	28	2,580	.....
9		[illegible]	19	.....	[illegible]	29	2,770	.....
10		[illegible]	20	4,[illegible]	[illegible]	30	2,950	.....
						31	4,170	.....

NOTE. [illegible] channels.

Monthly discharge of Marias River near Shelby, Mont., for 1907 and 1908.

[illegible]

Month.	Run-off.		Accuracy.
	[illegible]	Total in acre-feet.	
[illegible]	[illegible]	54,700	A.
[illegible]	[illegible]	458,000	A.
[illegible]	[illegible]	254,000	A.
[illegible]	[illegible]	92,700	A.
[illegible]	[illegible]	32,900	A.
[illegible]	[illegible]	32,300	B.
[illegible]	[illegible]	30,400	C.
[illegible]	[illegible]	30,300	D.
[illegible]		965,600	
[illegible]	[illegible]	5,600	D.

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TWO MEDICINE RIVER AT FAMILY, MONT.

This station, which is located at the Holy Family Mission, 16 miles southeast of Browning, Mont., and about 6 miles above the mouth of Badger Creek, the nearest tributary, was established April, 1907, to determine the amount of water available for irrigation.

The United States Reclamation Service has under consideration a project which will use about 200 second-feet of water for irrigating land north of the stream for the Blackfeet Indians. The water will be diverted near the mouth of Little Badger Creek, a small tributary entering from the south above the station. A storage reservoir will be built at Two Medicine Lake near the headwaters of the stream to augment the low-water flow. The only diversion from this stream at present is that made by a ditch which supplies water for about 100 acres of land on the farm at the Holy Family Mission. It heads about 2 miles above the gage.

The datum of the gage was lowered 0.95 foot July 21, 1908. The results are good at this station except during the winter months, when they are affected by ice.

Discharge measurements of Two Medicine River at Family, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 26	Robert Follansbee	84	222	3.05	488
May 18	J. E. Stewart	75	423	4.85	2,090
June 11	J. B. Pierson	85	460	4.65	2,110
July 12	....do	88	311	3.45	1,070
August 12	....do	43	135	2.29	265
September 2	....do	43	132	2.32	263
1908.					
April 13	A. F. Huch	86	307	3.20	770
May 18	....do	89	366	3.81	1,320
July 21 [a]	Stewart and Huch	100	138	2.68	375
August 18 [a]	....do	64	56.3	2.00	103
October 1 [a]	A. F. Huch	65	54.0	1.99	100

[a] Made by wading.

Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1907 and 1908.

[William Ripperger and Mike Kittson, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1					3.05	5.10	.....	2.60	2.35	2.20	1.60	1.60
2					3.00	5.60	4.35	2.60	2.30	2.15	1.60	1.60
3					3.10	5.30	4.25	2.60	2.30	2.10	1.60	1.55
4					3.05	4.90	4.40	2.60	2.28	2.05	1.60	1.55
5					3.20	4.80	4.30	2.55	2.25	2.05	1.60	1.50
6					3.18	4.90	3.95	2.50	2.28	2.00	1.60	1.50
7					3.30	4.95	3.80	2.45	2.30	1.95	1.60	1.45
8					4.50	5.60	3.55	2.40	2.30	1.95	1.60	1.40
9					4.15	5.30	3.55	2.35	2.30	1.90	1.60	1.40
10					4.80	5.00	3.55	2.35	2.30	1.90	1.60	1.40
11					5.00	4.70	3.50	2.35	2.35	1.90	1.60	1.55
12					4.60	4.60	3.50	2.30	2.40	1.85	1.60	1.55
13					4.10	4.65	3.50	2.25	2.40	1.85	1.60	1.55
14					4.50	4.55	3.40	2.20	2.35	1.85	1.60	1.55
15					4.70	4.40	3.30	2.20	2.35	1.85	1.60	1.55

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Daily gage height, in feet, of Two Medicine River at Family, Mont., for 1907 and 1908— Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
16					5.50	4.40	3.25	2.15	2.35	1.80	1.60	1.55
17					5.50	4.20	3.15	2.10	2.38	1.80	1.60	1.55
18					4.92	4.15	3.15	2.10	2.40	1.80	1.60	1.55
19					4.75	4.25	3.00	2.05	2.40	1.80	1.60	1.55
20					4.80	4.40	2.95	2.02	2.40	1.80	1.60	1.55
21					4.70	4.50	3.00	2.00	2.35	1.75	1.60	1.55
22					4.70	5.80	3.00	2.00	2.35	1.75	1.65	1.55
23					4.35	8.40	2.95	1.95	2.35	1.75	1.65	1.55
24					4.05	6.50	2.90	1.92	2.30	1.75	1.65	1.55
25					3.95	5.40	2.85	2.00	2.30	1.70	1.65	1.55
26				3.05	3.80	5.05	2.80	1.98	2.28	1.70	1.65	1.55
27				3.05	3.80	5.05	2.75	2.05	2.25	1.70	1.65	1.55
28				3.02	3.82	5.20	2.70	2.20	2.25	1.65	1.65	1.55
29				2.90	4.25	5.15	2.70	2.30	2.25	1.65	1.65	1.55
30				3.00	4.45	4.90	2.70	2.35	2.25	1.65	1.65	1.55
31					4.60		2.65	2.40		1.65		1.55
1908.												
1	1.4		1.3	1.75	2.80	6.20	3.0	2.5	2.1	2.0		
2	1.4		1.3	1.75	2.50	6.40	3.0	2.45	2.0	2.1		
3	1.4		1.3	1.83	2.60	6.80	3.0	2.35	2.1	2.0		
4	1.4		1.3	1.83	2.60	7.90	2.95	2.2	2.15	2.0		
5	1.4		1.3	1.83	2.80		2.95	2.25	2.2	2.1		
6	1.4		1.3	1.90	3.20		2.95	2.00	2.15	2.1		
7	1.4		1.3	1.95	3.60		3.0	1.9	2.1	2.0		
8	1.4		1.3	2.00	3.90		2.9	2.1	2.1	1.95		
9	1.4	1.3	1.75	2.03	4.10		3.1	2.2	2.0	1.95		
10	1.4	1.3	1.75	2.05	4.10		2.6	2.25	1.9	1.9		
11	1.4	1.3	1.75	2.08	4.20		2.4	2.35	1.95	1.95		
12	1.3	1.3	1.75	2.10	4.20		2.95	2.3	1.95	2.05		
13	1.3	1.3	1.75	2.10	4.20		2.6	2.35	1.9	2.1		
14	1.3	1.3	1.75	2.50	4.80		3.0	2.4	1.85	2.15		
15	1.3	1.3	1.75	2.50	5.10	4.4	2.95	2.35	1.9	2.1		
16	1.3	1.3	1.75	2.70	5.10		3.3	2.15	1.95	2.05		
17	1.3	1.3	1.75	3.10	4.30	3.9	3.0	2.2	1.95	2.0		
18	1.3	1.3	1.75	4.20	3.80	3.85	2.9	2.15	2.0			
19	1.3	1.3	1.75	4.20	3.80	3.7	2.9	2.15	1.95			
20	1.3	1.3	1.75	4.40	3.80	3.6	2.95	2.1	1.9			
21	1.3	1.3	1.75	4.50	3.70	3.5	2.75	2.2	1.85			
22	1.3	1.3	1.75	4.30	3.70	3.45	2.78	2.25	1.9			
23	1.3	1.3	1.75	3.80	3.70	3.4	2.75	2.3	1.95			
24	1.3	1.3	1.75	3.80	3.70	3.4	2.65	2.3	1.95			
25	1.3	1.3	1.75	3.80	3.70	3.75	2.65	2.25	1.9			
26	1.3	1.3	1.75	3.50	3.90	3.3	2.6	2.2	1.95			
27		1.3	1.75	3.50	3.80	3.3	2.5	2.0	2.00			
28		1.3	1.75	3.30	3.75	3.3	2.45	2.0	2.00			
29		1.3	1.75	3.20	3.90	3.1	2.4	2.1	1.95			
30			1.75	2.80	4.70	3.0	2.5	2.15	2.0			
31			1.75		5.30		2.45	2.15				

NOTE.—Gage washed out June 5, 1908. It was replaced June 15.

Rating tables for Two Medicine River at Family, Mont.

APRIL 26 TO JUNE 2, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	420	3.60	905	4.30	1,530	5.00	2,300
3.00	475	3.70	990	4.40	1,630	5.10	2,420
3.10	535	3.80	1,075	4.50	1,730	5.20	2,540
3.20	600	3.90	1,160	4.60	1,840	5.30	2,670
3.30	670	4.00	1,250	4.70	1,950	5.40	2,800
3.40	745	4.10	1,340	4.80	2,060	5.50	2,930
3.50	825	4.20	1,430	4.90	2,180	5.60	3,060

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the form of the subsequent curve. It is fairly well defined.

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Rating tables for Two Medicine River at Family, Mont.—Continued.

JUNE 3, 1907, TO JUNE 4, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	17	2.50	370	3.70	1,230	5.80	3,500
1.40	25	2.60	425	3.80	1,320	6.00	3,760
1.50	35	2.70	485	3.90	1,410	6.20	4,030
1.60	50	2.80	545	4.00	1,500	6.40	4,310
1.70	70	2.90	610	4.20	1,690	6.60	4,590
1.80	95	3.00	680	4.40	1,890	6.80	4,870
1.90	120	3.10	750	4.60	2,090	7.00	5,150
2.00	150	3.20	825	4.80	2,310	8.00	6,800
2.10	185	3.30	900	5.00	2,530	8.40	7,550
2.20	225	3.40	980	5.20	2,760		
2.30	270	3.50	1,060	5.40	3,000		
2.40	320	3.60	1,140	5.60	3,240		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during the above period, and is well defined between gage heights 2.0 feet and 5.0 feet.

JUNE 17 TO OCTOBER 17, 1908.

1.80	58	2.50	283	3.20	695	3.90	1,280
1.90	79	2.60	331	3.30	770	4.00	1,380
2.00	103	2.70	383	3.40	850	4.10	1,480
2.10	131	2.80	438	3.50	930	4.20	1,580
2.20	163	2.90	497	3.60	1,015	4.30	1,680
2.30	199	3.00	560	3.70	1,100	4.40	1,790
2.40	239	3.10	625	3.80	1,190		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and the form of the previous curve, and is fairly well defined below gage height 3.0 feet.

Monthly discharge of Two Medicine River near Family, Mont., for 1907 and 1908.

[Drainage area, 368 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 26–30	505	420	478	1.30	0.24	4,740	A.
May	2,930	475	1,500	4.08	4.70	92,200	A.
June	7,550	1,640	2,650	7.20	8.03	158,000	A.
July	2,130	455	982	2.67	3.08	60,400	A.
August	425	126	259	.704	.81	15,900	A.
September	320	248	282	.764	.85	16,800	A.
October	225	60	110	.299	.34	6,760	C.
November	60	50	53.0	.144	.16	3,150	D.
December	50	25	40.0	.109	.13	2,460	D.
The period						360,000	
1908.							
January	25		19.8	.054	.06	1,220	D.
February			17.0	.046	.05	978	D.
March	82	17	65.2	.177	.20	4,010	D.
April	1,990	82	704	1.91	2.13	41,900	B.
May	2,880	370	1,420	3.86	4.45	87,300	A.
June, 20 days		500	1,800	4.89	3.64	71,400	B.
July	770	239	449	1.22	1.41	27,600	B
August	283	79	171	.465	.54	10,500	C.
September	103	68	101	.274	.31	6,010	C.
October 1–17	147	79	112	.304	.19	3,780	C.
The period						255,000	

NOTE.—Discharge January 27–February 8, 1908, estimated.

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BADGER CREEK NEAR FAMILY, MONT.

This station, which is located near the road crossing 4 miles east of Family, Mont., was established April 20, 1907, to determine the amount of water available for irrigation. The United States Reclamation Service proposes to divert the natural flow of the stream to irrigate land in the eastern part of the Blackfeet Indian Reservation and north of Birch Creek.

The gage and bench marks were washed out in June, 1908, and a new gage was established July 22, 1908, about 400 feet farther up stream and at a different datum. As the bench mark was destroyed the relation between the two gages could not be determined.

On account of poor channel conditions and absence of high-water measurements, high-water records are only fair. The low records, however, are good.

Discharge measurements of Badger Creek near Family, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 26[a]	Robert Follansbee	53	80	1.35	239
July 23	J. B. Pierson	90	230	1.38	420
August 13	do	90	203	.98	288
September 4	do	90	194	.83	244
1908.					
April 16	A. F. Huch	90	184	.80	212
May 20	do	86	223	1.70	490
July 22[a]	Stewart and Huch	45	72.5	2.43	238
August 19[a]	do	33	41.6	2.10	153
October 1[a]	A. F. Huch	27	39.6	2.01	128

[a] Made by wading.

NOTE.—There was a marked change in the channel caused by high water in 1907.

Daily gage height, in feet, of Badger Creek near Family, Mont., for 1907 and 1908.

[J. T. Hockersmith, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
1		1.30	3.25	2.50	1.15	0.90	0.78	.....	.....
2		1.35	3.60	2.40	1.10	.88	.78	.....	.....
3		1.30	3.30	2.40	1.10	.85	.78	0.68	.....
4		1.35	2.95	2.30	1.10	.85	.78	.68	.....
5		1.30	2.95	2.20	.....	.85	.78	.65	.....
6		1.35	3.15	2.10	.....	.85	.78	.65	.....
7		1.40	3.25	2.00	.....	.85	.78	.65	.....
8		1.50	3.40	1.90	.....	.85	.75	.68	.....
9		1.80	3.15	1.90	1.02	.85	.75	.68	.....
10		2.10	3.00	1.90	1.02	.85	.72	.68	.....
11		2.50	2.90	1.85	1.00	.88	.72	.68	.....
12		2.30	2.80	1.75	.....	.88	.72	.68	.....
13		2.10	2.90	1.70	.....	.88	.72	.68	.....
14		2.00	2.75	1.65	.....	.90	.72	.68	.....
15		2.45	2.70	1.60	.92	.88	.72	.65	.....
		2.85	2.55	1.60	.90	.88	.70	.65	.....
		3.10	2.50	1.55	.90	.88	.70	.65	.....
		2.85	2.60	1.50	.90	.85	.70	.65	.....
		2.60	2.80	1.50	.90	.85	.70	.62	.....
		2.85	2.90	1.45	.90	.82	.70	.62	.....

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Daily gage height, in feet, of Badger Creek near Family, Mont., for 1907 and 1908— Continued.

Day.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
21	.....	2.80	2.85	1.40	0.88	0.82	0.70	0.60	.....
22	.....	2.80	3.30	1.35	.88	.80	.70	.60	.....
23	.....	2.55	.....	1.30	.90	.80	.70	.62	.....
24	.....	2.50	3.80	1.28	.90	.78	.70	.65	.....
25	.....	2.30	3.30	1.25	.90	.78	.70	.....	.....
26	.....	2.10	3.10	1.22	.90	.78	.70	.....	.....
27	1.35	2.10	3.15	1.20	.90	.78	.70	.....	.....
28	1.10	2.10	3.20	1.20	.95	.78	.68	.....	.....
29	1.25	2.45	3.00	1.30	.90	.78	.....	.....	.....
30	1.30	2.70	2.80	1.25	.85	.78	.....	.....	.....
31	.....	2.80	.....	1.20	.95	.....	.....	.....	.....
1908.									
1	.50	.95	3.90	.....	.....	.....	2.05	2.02	.....
2	.50	1.22	3.50	.....	.....	2.00	2.08	2.02	.....
3	.48	1.35	3.20	.....	.....	2.00	2.10	2.02	2.60
4	.48	1.28	5.90	.....	.....	.....	2.08	2.00	2.80
5	.48	1.42	.....	.....	.....	.....	2.08	2.00	3.00
6	.48	1.60	.....	.....	.....	.....	2.08	2.00	3.25
7	.48	1.90	.....	.....	.....	.....	2.05	2.00	3.50
8	.48	2.10	.....	.....	.....	2.00	2.05	2.00	3.75
9	.45	2.05	.....	.....	.....	2.00	2.05	2.00	3.40
10	.45	1.80	.....	.....	.....	1.95	2.08	2.00	3.40
11	.48	1.82	.....	.....	.....	1.95	2.08	2.00	3.40
12	.60	1.88	.....	.....	.....	1.95	2.10	2.00	3.40
13	.70	1.75	.....	.....	.....	1.95	2.20	2.00	3.40
14	.88	1.88	.....	.....	.....	1.95	2.30	2.00	.....
15	.85	1.95	.....	.....	.....	1.95	2.25	2.00	.....
16	.88	1.88	.....	.....	.....	1.95	2.20	2.00	.....
17	.88	1.75	.....	.....	.....	.....	2.18	2.00	.....
18	.90	1.68	.....	.....	.....	.....	2.15	2.00	.....
19	1.30	1.68	.....	.....	2.10	.....	2.12	2.00	.....
20	1.50	1.60	.....	.....	2.12	.....	2.12	2.00	3.40
21	1.72	1.60	.....	2.45	.....	.....	2.10	2.00	.....
22	1.50	1.60	.....	2.43	.....	.....	2.10	2.00	.....
23	1.70	1.60	.....	.....	.....	.....	2.10	1.98	.....
24	1.60	1.70	.....	.....	.....	.....	2.08	1.98	.....
25	1.40	2.00	.....	.....	.....	2.00	2.08	1.98	.....
26	1.22	2.20	.....	.....	.....	2.00	2.08	1.98	.....
27	1.15	2.00	.....	.....	.....	2.25	2.08	2.00	2.80
28	1.08	2.05	.....	.....	.....	2.25	2.05	2.00	.....
29	1.00	2.10	.....	.....	.....	2.50	2.05	2.00	.....
30	1.00	2.30	.....	.....	.....	2.50	2.05	.....	.....
31	.....	3.00	.....	.....	.....	.....	2.05	.....	.....

NOTE.—Gage washed out June 5, 1908; replaced July 22, 1908. New gage heights are not comparable with the old ones.
Ice conditions during December, 1907 and 1908.

Rating tables for Badger Creek near Family, Mont.

APRIL 26 TO JUNE 23, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	170	1.80	400	2.50	730	3.20	1,133
1.20	195	1.90	440	2.60	783	3.30	1,195
1.30	225	2.00	480	2.70	838	3.40	1,257
1.40	255	2.10	525	2.80	894	3.50	1,320
1.50	290	2.20	575	2.90	951	3.60	1,383
1.60	325	2.30	625	3.00	1,010		
1.70	360	2.40	677	3.10	1,071		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the form of subsequent curves and is only approximate.

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Rating tables for Badger Creek near Family, Mont.—Continued.

JUNE 24 TO NOVEMBER 24, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	190	1.50	464	2.40	876	3.30	1,410
.70	212	1.60	502	2.50	930	3.40	1,475
.80	236	1.70	542	2.60	985	3.50	1,540
.90	264	1.80	584	2.70	1,040	3.60	1,605
1.00	294	1.90	628	2.80	1,100	3.70	1,670
1.10	326	2.00	674	2.90	1,160	3.80	1,740
1.20	358	2.10	722	3.00	1,220		
1.30	392	2.20	772	3.10	1,280		
1.40	428	2.30	824	3.20	1,345		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and is fairly well defined below gage height 1.5 feet. Above gage height 1.5 feet the extension is uncertain.

APRIL 1 TO JUNE 4, 1908.

0.40	133	1.50	410	2.60	935	3.40	2,080
.50	151	1.60	450	2.70	990	3.60	2,220
.60	170	1.70	490	2.80	1,045	4.80	2,360
.70	190	1.80	535	2.90	1,105	5.00	2,500
.80	212	1.90	580	3.00	1,165	5.20	2,660
.90	235	2.00	625	3.20	1,285	5.40	2,820
1.00	259	2.10	675	3.40	1,410	5.60	2,980
1.10	285	2.20	725	3.60	1,540	5.80	3,140
1.20	313	2.30	775	3.80	1,670	6.00	3,300
1.30	343	2.40	825	4.00	1,800		
1.40	375	2.50	880	4.20	1,940		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the general form of the 1907 curve. It is fairly well defined below gage height 2.0 feet. Above 2.0 feet the rating is uncertain.

JULY 21 TO DECEMBER 31 1908.

1.90	145	2.14	151	2.30	204	2.50	261
2.00	127	2.20	177	2.40	232		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and is well defined. This table refers to the new gage established July 21, 1908.

Monthly discharge of Badger Creek near Family, Mont., for 1907 and 1908.

[Drainage area, 24 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 24–30	240	170	207	8.969	0.18	2,150	C.
May	1,070	225	2[illegible]	2.96	3.07	36,600	C.
June		240	1,140	3.09	2.68	67,800	C.
July	600	228	342	2.42	2.79	33,400	A.
August	342	228	264	1.37	1.46	17,300	A.
September	264	212	247	1.10	1.23	14,700	B.
October	228	206	218	.923	1.12	13,400	C.
November 1–23	228	190	202	.962	.83	9,620	C.
The year						196,000	
1908.							
April	600	242	353	1.72	1.25	14,900	B.
May	342	240	346	2.45	2.83	33,600	B.
June		228	230	.867	.68	8,090	B.
July	228	212	222	.879	.76	9,350	B.
August	212	212	212	.867	.62	7,360	C.

[illegible] second-feet. Discharge estimated September 1, 6-7,

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BIRCH CREEK NEAR DUPUYER, MONT.

This station, which is located at Shields ranch, 12 miles northwest of Dupuyer, Mont., and about 25 miles from its junction with Two Medicine River, was established July 25, 1907, to determine the amount of water available for irrigation projects on the Blackfeet Indian Reservation.

No storage is used on this stream, but a number of ditches divert water for irrigation. The largest of these, owned by the Conrad Investment Company, diverts water about one-half mile below the station.

The gage datum remained the same from the time the station was established until the high water of June, 1908, when the gage was washed away and the channel changed. A temporary staff gage was put in July 23, 1908, about 200 feet below the original gage. This gage was used until October 1, 1908, when a permanent chain gage was established one-fourth mile above.

Discharge measurements of Birch Creek near Dupuyer, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 25	Robert Follansbee	73	120	3.20	296
August 14	J. B. Pierson	70	95	2.85	182
September 3	do	65	86	2.71	160
1908.					
April 14	A. F. Huch	65	84.5	2.71	152
May 19	do	70	120.	3.32	381
July 23[a]	Stewart and Huch	35	76.6	2.44	108
August 19[a]	do	30	52.3	2.20	113

[a] Made by wading.

Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1907 and 1908.

[R. F. Shields and R. A. Earhart, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1	.....	3.05	2.8	2.6	2.5	2.45	16	.....	2.8	2.7	2.5	2.45	.....
2	.....	3.05	2.75	2.6	2.5	2.45	17	.....	2.8	2.65	2.5	2.45	.....
3	.....	3.05	2.7	2.6	2.5	2.45	18	.....	2.8	2.65	2.5	2.45	.....
4	.....	3.05	2.7	2.6	2.5	2.45	19	.....	2.8	2.65	2.5	2.45	.....
5	.....	3.0	2.7	2.6	2.5	2.45	20	.....	2.8	2.65	2.5	2.45	.....
6	.....	2.95	2.7	2.6	2.5	2.45	21	.....	2.8	2.65	2.5	2.45	.....
7	.....	2.9	2.7	2.6	2.5	2.45	22	.....	2.75	.....	2.5	2.45	.....
8	.....	2.85	2.7	2.6	2.5	2.45	23	.....	2.75	.....	2.5	2.45	.....
9	.....	2.8	2.7	2.55	2.5	2.45	24	.....	2.75	.....	2.5	2.45	.....
10	.....	2.8	2.7	2.55	2.5	2.45	25	.....	2.75	.....	2.5	2.45	.....
11	.....	2.8	2.7	2.55	2.45	2.45	26	3.1	2.75	.....	2.5	2.45	.....
12	.....	2.8	2.7	2.55	2.45	2.45	27	3.1	2.8	.....	2.5	2.45	.....
13	.....	2.8	2.75	2.55	2.45	2.45	28	3.1	2.8	.....	2.5	2.45	.....
14	.....	2.8	2.75	2.5	2.45	2.45	29	3.1	2.8	.....	2.5	2.45	.....
15	.....	2.8	2.7	2.5	2.45	.....	30	3.1	2.8	.....	2.5	2.45	.....
							31	3.05	2.85	.....	.....	.....	.....

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Daily gage height, in feet, of Birch Creek near Dupuyer, Mont., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1		2.30	2.80	5.99		2.30	2.15	3.95	4.04	3.87
2		2.25	2.87	6.00		2.32	2.18	4.04	4.05	3.88
3		2.25	2.92	5.13		2.25	2.13	4.03	4.05	3.94
4		2.25	2.87	6.83		2.32	2.10	4.04	4.05	4.35
5		2.25	2.94			2.35	2.20	4.10	4.05	4.05
6		2.25	3.25			2.36	2.12	4.09	4.05	4.04
7		2.25	3.17			2.25	2.20	4.13	4.08	4.17
8		2.25	3.34			2.35	2.10	4.10	4.02	3.98
9		2.25	3.24			2.27	2.15		3.98	3.91
10		2.30	3.26			2.30	2.13	4.11	3.98	3.83
11		2.35	3.32			2.23	2.10	4.10	4.00	4.03
12		2.50	3.38			2.25	2.80	4.10	3.99	4.00
13		2.55	3.32			2.26	2.60	4.11	3.95	3.88
14		2.55	3.42			2.35	2.50	4.18	3.89	4.00
15	2.30	2.60	3.50			2.28	2.50	4.18	3.88	4.83
16	2.30	2.60	3.49			2.28	2.50	4.19	3.87	4.51
17	2.30	2.60	3.42			2.26	2.18	4.15	3.95	4.32
18	2.30	2.70	3.36			2.30	2.17	4.14	3.96	4.10
19	2.30	3.10	3.72			2.30	2.15	4.13	3.95	4.52
20	2.30	3.20	3.30			2.23	2.13	4.11	3.94	4.80
21	2.30	3.30	3.32			2.24	2.70	4.01	3.93	4.88
22	2.30	3.30	3.29			2.28	2.50	4.02	3.93	4.89
23	2.25	3.30	3.28		2.44	2.30	2.80		3.93	
24	2.25	3.25	3.35		2.56	2.28	2.80	4.04	3.94	
25	2.30	3.10	3.27		2.30	2.30		4.08		
26	2.35	2.90	3.46		2.50	2.30		4.05	3.94	
27	2.40	2.90	3.55		2.40	2.30		4.03	4.00	
28	2.50	2.85	3.44		2.60	2.21	2.15	4.04	3.95	
29	2.55	2.80	3.49		2.40	2.18	2.25	4.05	3.89	
30	2.30	2.80	3.24		2.30	2.18	2.23	4.05	3.86	
31	2.30		4.60		2.30	2.30		4.04		

NOTE.—Gage washed out June 5, 1907. Observer away September 23–30, 1907. Ice conditions December 15–31, 1907, and December 25–31, 1908.

Rating tables for Birch Creek near Dupuyer, Mont.

JULY 25, 1907, TO JUNE 4, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,565
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,720
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,880
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,050
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,230
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,420
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,620
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

NOTE.—[illegible] It is based on five discharge measurements made between gage heights 2.5 feet and [illegible]

JULY 23 TO SEPTEMBER 30, 1908.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	244
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	271

The above table is based on [illegible] It is based on two measurements made during [illegible] and is fairly well defined.

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Monthly discharge of Birch Creek, near Dupuyer, Mont., for 1907 and 1908.

[Drainage area, 155 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
July 25-31	288	250	268	1.73	0.45	3,720	A.
August	250	166	189	1.22	1.41	11,600	B.
September	177	.....	150	.968	1.08	8,930	B.
October	133	116	122	.787	.91	7,500	B.
November	116	109	111	.716	.80	6,600	C.
December 1-14	109	109	109	.703	.37	3,030	C.
1908.							
March 15-31	116	85	92.4	.596	.38	3,120	C.
April	355	85	167	1.08	1.20	9,940	A.
May	1,310	177	390	2.52	2.90	24,000	A.
July 23-31	211	133	169	1.09	.36	3,020	B.
August	147	109	126	.813	.94	7,750	B.
September	281	95	150	.968	1.08	8,930	B.

NOTE.—Discharge June 4, 1908, estimated. Discharge interpolated for missing days in September, 1908.

DUPUYER CREEK AT DUPUYER, MONT.

This station, which is located at the highway bridge at Dupuyer, Mont., was established April 15, 1908, to obtain data for use in connection with irrigation projects in that locality.

The datum of the gage has not been changed since the station was established. Frequent discharge measurements are necessary to insure good results at this station as the channel conditions are poor. Ice affects the results during the winter months.

Discharge measurements of Dupuyer Creek at Dupuyer, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 14	A. F. Huch	38	46.1	1.22	21.9
May 19[a]	do	30	28.9	1.65	65.9
June 16	do	40	54.8	2.37	253
July 22[a]	Stewart and Huch	26	31.1	1.28	53.1
August 19[a]	do	23	27.4	1.08	32.7

[a] Made by wading.

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Daily gage height, in feet, of Dupuyer Creek at Dupuyer, Mont., for 1908.

[George A. Little and Hildreath Miller, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.24	2.40	2.10	1.08	0.98	1.05	1.03	2.01
2	.....	1.24	2.02	2.08	1.08	.98	1.02	1.03	2.02
3	.....	1.12	2.32	2.07	1.06	.98	1.03	1.03	2.00
4	.....	1.18	3.02	2.04	1.06	.96	1.03	1.03	2.00
5	.....	1.16	4.80	2.01	1.03	.95	1.03	1.03	2.00
6	.....	1.14	4.70	2.00	.99	.94	1.04	1.03	.....
7	.....	1.14	3.98	1.98	.98	.90	1.03	1.03	.....
8	.....	1.14	3.96	1.98	.96	.88	1.02	1.03	.....
9	.....	1.24	3.91	1.94	.94	.85	1.02	1.04	.....
10	.....	1.37	3.82	1.88	.92	.85	1.02	1.04	.....
11	.....	1.42	3.74	1.86	.88	.85	1.02	1.04	.....
12	.....	1.47	3.64	1.84	.91	.85	1.02	1.04	.....
13	.....	1.52	3.54	1.91	1.46	.82	1.02	1.05	.....
14	.....	1.61	3.24	2.06	1.39	.82	1.02	1.09	.....
15	1.22	1.74	2.76	2.02	1.30	.82	1.02	2.00	.....
16	1.21	1.78	2.36	1.96	1.26	.86	1.02	1.06	.....
17	1.21	1.71	2.32	1.93	1.14	.94	1.03	1.04	.....
18	1.21	1.68	2.30	1.89	1.08	.95	1.02	1.04	.....
19	1.22	1.66	2.29	1.68	1.10	.95	1.02	1.04	.....
20	1.22	1.66	2.28	1.66	1.10	.95	1.02	1.04	.....
21	1.22	1.65	2.27	1.64	1.10	.90	1.02	1.04	.....
22	1.22	1.64	2.24	1.51	1.05	.90	1.02	1.04	.....
23	1.23	1.62	2.20	1.32	1.05	.90	1.02	1.04	.....
24	1.23	1.58	2.20	1.27	1.00	.95	1.04	1.04	.....
25	1.23	1.59	2.18	1.23	1.00	.95	1.04	1.04	.....
26	1.23	1.62	2.16	1.22	1.00	1.00	1.03	1.04	.....
27	1.24	1.87	2.16	1.22	1.00	1.02	1.03	1.05	.....
28	1.24	1.88	2.15	1.10	1.00	1.02	1.03	1.10	.....
29	1.24	1.78	2.14	1.10	1.00	1.03	1.03	1.11	.....
30	1.24	1.80	2.13	1.10	1.00	1.03	1.04	2.00	.....
31	.....	1.99	.....	1.08	.99	.....	1.04	.....	.....

NOTE.—Ice conditions November 15, November 28–December 31.

Rating tables for Dupuyer Creek at Dupuyer, Mont.

APRIL 14 TO JUNE 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	14	2.00	116	2.90	335	3.80	660
1.20	21	2.10	133	3.00	370	3.90	700
1.30	29	2.20	152	3.10	405	4.00	740
1.40	38	2.30	173	3.20	440	4.20	820
1.50	48	2.40	195	3.30	475	4.40	900
1.60	59	2.50	220	3.40	510	4.60	980
1.70	71	2.60	245	3.50	545	4.80	1,060
1.80	85	2.70	275	3.60	580		
1.90	100	2.80	305	3.70	620		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during the above period and the form of the subsequent curve, and is not well defined. Above gage height 2.0 feet this table is only approximate.

JUNE 6 TO NOVEMBER 27, 1908.

0.80	10	1.60	98	2.40	257	3.40	580
0.90	17	1.70	114	2.50	284	3.60	650
1.00	25	1.80	131	2.60	313	3.80	720
1.10	34	1.90	149	2.70	343	4.00	790
1.20	44	2.00	168	2.80	375	4.20	870
1.30	56	2.10	188	2.90	407	4.40	950
1.40	69	2.20	209	3.00	440	4.60	1,030
1.50	83	2.30	232	3.20	510	4.80	1,110

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is fairly well defined below gage height 2.5 feet.

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Monthly discharge of Dupuyer Creek at Dupuyer, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 14–30	24	22	23.1	779	C.
May	114	15	54.1	3,330	B.
June	1,070	119	405	24,100	B.
July	188	32	120	7,380	A.
August	77	16	31.5	1,940	B.
September	28	11	19.3	1,150	C.
October	30	27	27.7	1,700	C.
November	33	28	29.1	1,730	C.
The period				42,100	

NOTE.—Discharge estimated for November 15, 28–30.

TETON RIVER NEAR BELLEVIEW, MONT.

Teton River, the most important tributary of Marias River, rises in the Rocky Mountains and flows eastward in a course approximately parallel to that of Sun River, crossing and recrossing the sixth standard parallel north, and emptying into the Marias River about a mile above the point where the latter joins the Missouri.

This station, which is located 1 mile north of Peeble's ranch, 16 miles above Chouteau, Mont., was established November 26, 1904, to obtain data for use in connection with irrigation projects. The nearest post-office is Belleview.

No important tributaries enter the stream near the station. Practically no water is diverted above the station, but the ordinary flow below is appropriated and used for irrigation.

An irrigation project now being constructed under the Carey Act proposes to store the flood water of Teton River in a reservoir located about 5 miles north of the gaging station. The water will be diverted one-half mile above the gage. The capacity of the reservoir is 90,000 acre-feet and can be increased to 210,000 by raising the top of the dam 20 feet. It will serve 120,000 acres of land on the north side of the river.

The first gage was spiked to a post on the left bank about 40 feet above the bend of Kroff's irrigation ditch. March 9, 1905, it was moved by the observer 250 feet upstream to avoid the effect of the dam erected at the head of the ditch below. On May 8, 1905, the gage was referred to the bench marks, and it was found that the datum had been raised 0.78 foot in moving, while the difference between the level of the water surface at the old and new locations was but 0.10 foot. The gage datum was lowered on this date 0.20 foot. May 8, 1906, the gage was again moved 1½ miles up stream to Mr. Bjornstad's new ranch and set at an entirely different datum. The station was discontinued during 1907, but was reestablished

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again June 16, 1908, near the location of the gage that was used during 1906, but there is no connection between the gage reading.

The current is swift at the gage and the river never freezes entirely across. The conditions for obtaining accurate discharge data during high water are rather poor on account of the shifting channel.

Discharge measurements of Teton River near Belleview, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 16 a	J. E. Stewart	65	146	6.98	841
July 8 b	Raymond Richards	33	77.1	5.55	297
August 31 b	do	40	52.1	4.84	113
October 14 b	do	42	49.5	4.81	89

a Made from cable. b Made by wading.

Daily gage height, in feet, of Teton River near Belleview, Mont., for 1908.

[Belle Peebles, observer.]

Day	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.9	5.65	5.0	4.8	4.7	4.7	4.6	16	7.1	5.55	4.9	4.7	4.8	4.7	4.6
2	7.0	5.7	5.0	4.8	4.8	4.7	4.6	17	6.95	5.5	4.9	4.7	4.8	4.7	4.6
3	7.1	5.65	5.0	4.8	4.8	4.7	4.6	18	6.9	5.4	4.9	4.8	4.8	4.7	4.5
4	7.05	5.65	5.0	4.8	4.8	4.7	4.6	19	6.75	5.35	4.9	4.8	4.8	4.7	4.5
5	7.1	5.6	5.0	4.7	4.8	4.7	4.6	20	6.55	5.3	4.9	4.7	4.8	4.7	4.5
6	7.25	5.6	5.0	4.7	4.8	4.8	4.6	21	6.35	5.3	4.9	4.7	4.7	4.7	4.5
7	7.3	5.6	5.0	4.7	4.8	4.8	4.6	22	6.3	5.2	4.9	4.7	4.7	4.7	4.5
8	7.25	5.5	5.0	4.7	4.7	4.8	4.6	23	6.25	5.2	4.9	4.7	4.7	4.7	4.5
9	7.2	5.5	4.9	4.7	4.7	4.8	4.7	24	6.2	5.2	4.9	4.7	4.7	4.7	4.5
10	7.25	5.5	4.9	4.7	4.8	4.8	4.7	25	6.1	5.2	4.8	4.7	4.7	4.6	4.5
11	7.2	5.5	4.9	4.7	4.8	4.7	4.7	26	6.0	5.1	4.8	4.7	4.7	4.6	4.5
12	7.2	5.5	4.9	4.7	4.8	4.7	4.7	27	5.9	5.1	4.8	4.7	4.7	4.6	4.4
13	7.0	5.5	4.9	4.7	4.8	4.7	4.6	28	5.9	5.1	4.8	4.7	4.7	4.6	4.4
14	7.05	5.5	4.9	4.7	4.8	4.7	4.7	29	5.7	5.1	4.8	4.7	4.7	4.6	4.5
15	7.05	5.5	4.9	4.7	4.8	4.7	4.7	30	5.7	5.1	4.8	4.7	4.7	4.6	4.5
								31	.....	5.1	4.8	.....	4.7	.....	4.6

Rating table for Teton River near Belleview, Mont., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
[illegible]							

[illegible] It is based on four [illegible] gage heights 4.6 feet and 7.5

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Monthly discharge of Teton River near Belleview, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	1,080	345	909	54,100	A.
July	345	167	253	15,600	A.
August	141	95	118	7,260	B.
September	95	76	79.8	4,750	B.
October	95	76	86.4	5,310	B.
November	95	60	78.5	4,670	B.
December	76	33	55.4	3,410	C.
The period				95,100	

MUSSELSHELL RIVER DRAINAGE BASIN.

DESCRIPTION.

Musselshell River is formed by two forks. The North Fork (or master stream) rises on the southern slopes of the Little Belt Mountains in the northern part of Meagher County, Mont., at an elevation of 8,000 feet above sea level, flows southeastward for 10 miles, emerging into an irrigable valley, one-half mile to 1 mile in width, and joining the South Fork near the town of Martinsdale, 30 miles below its source, at an elevation of 4,700 feet above sea level. The South Fork has its source in several small streams draining the northward slopes of Crazy Mountains, about 20 miles southwest of Martinsdale at an elevation of 5,500 feet above sea level, and flows northeastward through a valley 1 mile to 3 miles wide. From Martinsdale the Musselshell flows almost due east for 130 miles to Melstone, where it turns abruptly to the north, and 60 miles farther on it enters the Missouri.

Below the forks the valley widens and is bordered by low rolling hills. The larger part of the basin is covered by glacial deposits. The soil is black loam, and when properly irrigated the land is suitable for agriculture. Forestation is scant. At the headwaters of the North Fork pines are found, but elsewhere the timber consists only of the few cottonwoods and willows that border the stream channels. The mean annual rainfall is about 25 inches in the upper areas of the basin, but near the mouth of the river it decreases to 12 inches.

The principal source of supply for the streams in this basin is the melting snow. Ice forms on the streams during the winter months.

The tributaries of the Musselshell are small intermittent streams and the river exhibits wide variations in discharge. Much of the water is used for irrigation, the diversions all being small. During the irrigating season the Musselshell carries but little water.

A project now under way under the Carey Land Act will utilize a small but excellent reservoir site on the North Fork to store the flood waters of that stream and of Checkerboard Creek which will be

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[illegible] The dam will be 120 feet high and the [illegible] of water. The dam site is 19½ [illegible]

[illegible] efforts to opportunities for power develop- [illegible] of greatest magnitude occurs in the Upper North [illegible] of water is insufficient to warrant an expendi- [illegible] it.

[illegible] of stream flow in the Musselshell basin have [illegible] and Harlowton. The wettest year recorded [illegible] the driest was 1906.

[illegible] gaging stations have been maintained in this drainage [illegible]

[illegible] Musselshell River near Martinsdale, Mont., 1907–8.
[illegible] Musselshell River at Harlowton, Mont., 1907–8.
[illegible] Musselshell River at Shawmut, Mont., 1902–1907.
[illegible] Musselshell River at Lavina, Mont., 1906.
[illegible] Fork of Musselshell River near Martinsdale, Mont., 1907–8.
[illegible] Fork near Harlowton, Mont., 1907–8.
[illegible] Creek near Harlowton, Mont., 1907–8.

SOUTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established July 10, 1907, to determine the amount of water available for irrigation, is located at the ranch of Martin J. Settle, 4 miles north of Martinsdale and one-half mile above the junction of the North and South forks.

All the tributaries to the North Fork enter the stream above the station, the principal ones being Checkerboard and Flagstaff creeks.

Under a Carey Land Act project the water of this fork, which is practically all appropriated, will be stored about 20 miles above the station and used to irrigate land between Martinsdale and Harlowton.

The bed of the stream is composed of gravel and may shift somewhat during high water, as the current is swift. Ice forms during the winter season, but records obtained during the open season are very good.

[illegible] of South Fork of Musselshell River near Martinsdale, Mont., [illegible] and 1908.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	Sq. ft.	Feet.	Sec.-ft.
[illegible]	38.0	.....		109
[illegible]	32.0	4.48		210
[illegible]	34.8	3.90		104
[illegible]	24.4	3.42		433
[illegible]	21.0	3.30		28.9
[illegible]	20.1	3.27		29.6
[illegible]	27.5	5.88		436
[illegible]	22.5	3.85		95.7
[illegible]	9.4	3.00		7.4
[illegible]	15.0	3.21		19.2

[illegible] Discharge measurements of South Fork of Musselshell River near Martinsdale, Mont., in 1907 and 1908.

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Daily gage height, in feet, of North Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

[Martin J. Settle, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1	.....	3.6	3.4	3.45	3.35	3.35	16	4.25	3.5	3.4	3.25	.....	4.9
2	.....	3.7	3.4	3.4	3.3	3.35	17	4.0	3.5	3.4	3.35	3.4	.
3	.....	3.65	3.3	3.4	3.3	3.35	18	3.9	3.45	3.4	3.35	3.4	. .
4	.....	3.6	3.4	3.3	3.3	3.4	19	4.0	3.45	3.3	3.35	3.4	..
5	.....	3.6	3.4	3.4	3.35	3.4	20	4.1	3.45	3.4	3.25	3.4	...
6	.....	3.6	3.4	3.4	3.35	3.7	21	4.55	3.5	3.4	3.35	3.35	.....
7	.....	3.55	3.4	3.4	3.35	3.5	22	4.2	3.5	3.3	3.35	3.45	. ..
8	.....	3.55	3.4	3.3	3.35	3.3	23	4.0	3.4	3.3	3.35	3.5	..
9	.....	3.55	3.4	3.4	3.35	3.65	24	3.9	3.45	3.3	3.25	3.5	. ..
10	4.5	3.7	3.4	3.4	3.35	3.6	25	3.85	3.35	3.3	3.35	3.5	....
11	4.1	3.75	3.4	3.4	3.45	3.5	26	3.85	3.35	3.4	3.35	3.35	.....
12	4.0	3.55	3.45	3.3	3.45	3.8	27	3.9	3.35	3.3	3.35	3.5	. ..
13	4.0	3.5	3.45	3.4	3.45	3.8	28	3.8	3.45	3.4	3.9	3.5	. .
14	5.0	3.6	3.4	3.4	.....	4.7	29	3.8	3.4	3.4	3.35	3.4	. ..
15	4.25	3.5	3.3	3.35	.....	4.7	30	3.8	3.4	3.4	3.35	3.35	.. ...
							31	3.75	3.4	.....	.....	.....	

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	.....	3.2	6.2	3.45	3.05	3.2	3.25	3.45
2	.....	3.2	6.0	3.4	3.05	3.2	3.25	3.45
3	.....	3.2	5.95	3.35	3.05	3.2	3.3	3.45
4	.....	3.1	6.1	3.3	3.0	3.2	3.35	3.45
5	3.25	3.1	5.9	3.3	3.0	3.05	3.4	3.45
6	3.25	3.1	6.25	3.3	3.0	3.2	3.45	3.45
7	3.25	3.05	6.1	3.25	2.95	3.05	3.4	3.45
8	3.25	3.0	5.8	3.2	2.9	3.05	3.4	3.45
9	3.25	3.0	5.5	3.15	2.85	3.05	3.35	3.45
10	3.5	3.0	5.2	3.1	2.85	3.05	3.35	4.0
11	3.6	3.0	5.0	3.1	2.85	3.05	3.35	4.2
12	3.6	3.0	4.75	3.1	2.85	3.05	3.45	4.25
13	3.45	3.0	4.5	3.1	3.1	3.05	3.4	4.3
14	3.4	3.0	4.35	3.1	3.4	3.2	3.4	4.3
15	3.4	3.0	4.25	3.1	3.25	3.2	3.45	4.0
16	3.4	3.0	4.2	3.1	3.25	3.05	3.45	3.5
17	3.4	3.0	4.2	3.1	3.25	3.2	3.45	3.45
18	3.3	3.0	4.15	3.1	3.25	3.2	3.45	3.4
19	3.3	2.95	4.1	3.1	3.25	3.2	3.45	3.5
20	3.3	3.0	4.05	3.1	3.25	3.2	3.45	3.45
21	3.3	3.0	4.0	3.1	3.25	3.2	3.45	3.45
22	3.3	3.0	3.95	3.1	3.25	3.2	3.45	3.45
23	3.3	3.1	3.85	3.1	3.25	3.2	3.45	3.45
24	3.25	3.05	3.8	3.05	3.2	3.25	3.45	3.4
25	3.25	3.1	3.75	3.0	3.2	3.4	3.45	3.45
26	3.25	3.15	3.7	3.0	3.15	3.3	3.45	3.5
27	3.25	3.7	3.6	3.0	3.15	3.3	3.45	3.4
28	3.25	3.5	3.6	3.0	3.15	3.3	3.45	3.4
29	3.3	3.45	3.5	3.0	3.2	3.3	3.45	3.4
30	3.2	3.85	3.45	3.0	3.2	3.25	3.45	3.4
31	.....	5.65	.....	3.0	3.2	.....	3.45	.....

NOTE.—Ice conditions during December, 1907, and November 16–December 31, 1908.

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Rating table for North Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.85	3	3.70	76	4.50	200	5.30	346
2.90	4	3.80	90	4.60	217	5.40	365
3.00	7	3.90	105	4.70	235	5.50	384
3.10	12	4.00	120	4.80	253	5.60	403
3.20	19	4.10	135	4.90	271	5.70	422
3.30	28	4.20	151	5.00	289	5.80	441
3.40	39	4.30	167	5.10	308	5.90	460
3.50	51	4.40	183	5.20	327	6.00	479
3.60	63						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nine discharge measurements made during 1907–8 and is well defined below gage height 4.0 feet and fairly well defined between gage heights 4.0 feet and 6.0 feet.

Monthly discharge of North Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
July 10–31	289	83	132	5,760	A.
August	83	34	52.6	3,230	A.
September	44	28	36.4	2,170	A.
October	44	24	34.2	2,100	A.
November	51	28	39.1	2,330	A.
1908.					
April 5–30	63	19	32.0	1,650	B.
May	412	5.5	32.4	1,990	B.
June	529	44	239	14,200	A.
July	44	7	15.7	965	C.
August	39	3	16.2	996	C.
September	39	10	18.5	1,100	C.
October	44	24	40.1	2,470	B.
November 1–9	44	44	44.0	785	B.
The period				24,200	

MUSSELSHELL RIVER AT HARLOWTON, MONT.

This station, which was established July 11, 1907, to take the place of the station formerly maintained at Shawmut, is located at the highway bridge 1 mile south of Harlowton. The records furnish information of value for irrigation development.

The tributaries above and below the station are all small streams. American Fork enters the stream between this station and Shawmut.

A large part of the valley is irrigated and many small ditches also receive their water supply from the Musselshell. Practically the entire flow of the stream is appropriated. A minimum discharge [illegible] is essential during the irrigating season at this

[illegible] unchanged. The bed of the stream [illegible] and may shift. Records obtained

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During the high water of June, 1908, the approaches to the bridge were partly destroyed, but the gage was not disturbed. In October, 1908, the bridge caved in, destroying the gage.

Discharge measurements of Musselshell River at Harlowton, Mont., in 1907 and 1908.

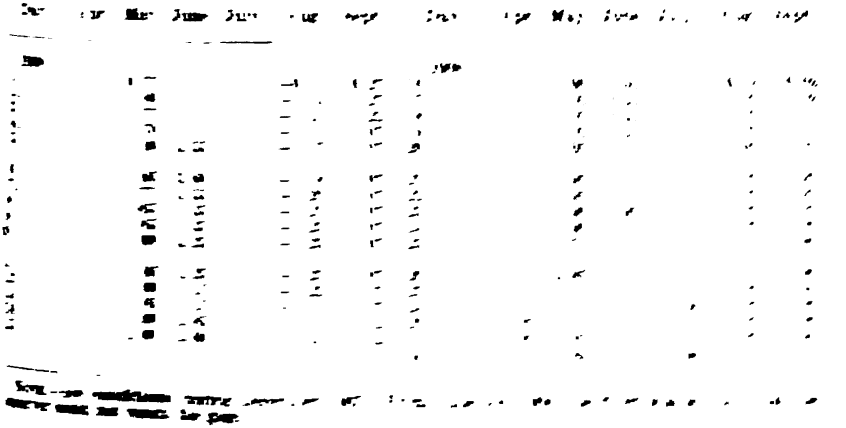
Date.	Hydrographer.	Width.	Area of section.	Gage height	Discharge
1907.		*Feet.*	*Sq. ft.*	*Feet*	*Sec. ft*
July 12	Robert Follansbee	99	170	1.72	475
July 28	J. E. Stewart	92	137	1.38	275
September 6	do	90	122	1.20	110
October 31	do	89	112	1.07	118
1908.					
April 29	Raymond Richards	87	101	.80	122
June 23	J. E. Stewart	90	274	1.95	554
July 28 *a*	Raymond Richards	14	8.0	.04	11
September 25 *a*	do	25	14.2	.40	20.8

a Made by wading.

Daily gage height, in feet, of Musselshell River at Harlowton, Mont., for 1907 and 1908.

[H. C. Hopkins and Frank A. Smith, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1907.						1907.					
1.	....	1.38	1.30	1.10	1.00	16.	2.00	1.25	1.25	1.12	1.00
2.	....	1.30	1.25	1.15	1.00	17.	1.85	1.20	1.20	1.10	1.00
3.	....	1.30	1.25	1.15	1.00	18.	1.75	1.12	1.20	1.10	1.00
4.	....	1.50	1.20	1.15	1.05	19.	1.70	1.10	1.18	1.10	1.02
5.	....	1.45	1.20	1.15	1.05	20.	1.70	1.15	1.15	1.10	1.00
6.	....	1.38	1.20	1.15	1.00	21.	2.00	1.10	1.15	1.10	1.00
7.	....	1.35	1.20	1.15	1.00	22.	2.15	1.12	1.15	1.08	1.00
8.	....	1.25	1.20	1.15	1.00	23.	1.90	1.15	1.15	1.05	1.00
9.	....	1.30	1.20	1.15	1.00	24.	1.75	1.18	1.10	1.05	1.00
10.	....	1.25	1.20	1.15	1.00	25.	1.55	1.20	1.10	1.05	1.00
11.	....	1.40	1.20	1.15	1.00	26.	1.60	1.18	1.10	1.07	1.00
12.	....	1.40	1.20	1.15	1.00	27.	1.42	1.15	1.10	1.06	1.00
13.	....	1.35	1.25	1.15	.95	28.	1.40	1.10	1.10	1.06	1.00
14.	....	1.30	1.25	1.15	.95	29.	1.30	1.08	1.10	1.06	1.00
15.	1.30	1.30	1.25	1.15	.90	30.	2.10	1.05	1.10	1.06	1.00
						31.	1.50	1.05		1.06	



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Rating tables for Musselshell River at Harlowton, Mont.

JULY TO AUGUST 10, 1907, AND APRIL 29 TO SEPTEMBER 30, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
−0.25	0	0.80	112	1.90	530	3.00	1,330
−.20	1	.90	135	2.00	590	3.20	1,490
−.10	2	1.00	160	2.10	655	3.40	1,655
.00	5	1.10	188	2.20	725	3.60	1,825
.10	10	1.20	219	2.30	795	3.80	2,000
.20	17	1.30	253	2.40	865	4.00	2,180
.30	27	1.40	290	2.50	940	4.20	2,360
.40	40	1.50	330	2.60	1,015	4.40	2,540
.50	55	1.60	374	2.70	1,090	4.60	2,720
.60	72	1.70	422	2.80	1,170	4.80	2,900
.70	91	1.80	474	2.90	1,250	5.00	3,080

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made 1907–8, and is well defined between gage heights 0 foot and 2.0 feet. Above gage height 2.0 feet the curve is only approximate.

AUGUST 11, 1907, TO NOVEMBER 30, 1907.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Musselshell River at Harlowton, Mont., August 11 to November 30, 1907.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1	.....	190	108	105	16	227	140	125	105
2	.....	165	110	105	17	210	123	125	105
3	.....	155	115	105	18	195	123	125	105
4	.....	140	120	118	19	180	115	125	110
5	.....	130	120	118	20	190	110	125	118
6	.....	120	125	105	21	170	110	125	118
7	.....	120	125	105	22	185	110	120	118
8	.....	120	125	105	23	190	110	115	118
9	.....	120	125	105	24	190	108	115	105
10	.....	122	125	105	25	195	108	115	105
11	480	122	125	105	26	185	108	108	105
12	315	122	125	105	27	170	108	108	105
13	280	135	125	95	28	170	108	105	105
14	245	145	125	95	29	180	108	105	105
15	240	140	125	100	30	185	108	105	105
					31	185	.....	105	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Musselshell River at Harlowton, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
July 11–31	865	272	471	19,600	A.
August	700	170	250	15,400	C.
September	190	108	125	7,440	C.
October	125	105	119	7,320	C.
November	118	95	107	6,370	C.
1908.					
[illegible]	2,940	91	643	39,500	A.
[illegible]	1,820	560	1,210	45,600	B.
[illegible]	24	.4	5.56	342	D.
[illegible]	50	4.1	21.6	1,290	D.

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MUSSELSHELL RIVER AT SHAWMUT, MONT.

This station, which was established August 12, 1902, to determine the amount of water available for irrigation and storage, was located at the ranch of the Bloomington Land and Cattle Company, one-eighth mile from the post-office of Shawmut and 25 miles east of Harlowton.

The station was maintained for several years, but the continuity of the records was frequently interrupted because of the difficulty of obtaining an observer. For this reason, and because of the heavy expense incidental to a station so inaccessible, it was abandoned on June 30, 1907, and a new station was established.

Many small and intermittent streams enter above and below the station. American Fork, which comes in 15 miles above, is one of the more important of these tributaries.

Irrigation is extensively developed along the Musselshell, and many diversions are made both above and below the station. The water is practically all appropriated.

On April 22, 1905, a new gage was established on the right bank 400 feet below the old gage, with a datum 0.29 foot greater. Thereafter until the station was discontinued the gage datum remained unchanged.

Records obtained during the open season were fair.

Discharge measurements of Musselshell River at Shawmut, Mont., in 1907

Date.	By	Area of section.	Gage height.	Discharge.
April 28	J. E. Stewart	[illegible]	[illegible]	[illegible]
June 20	do	[illegible]	[illegible]	[illegible]

Note.—The above measurements were made at different sections.

Daily gage height, in feet, of Musselshell River at Shawmut, Mont., for 1907

(J. E. Stewart, observer.)

Day	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
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18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											

Note.—[illegible]

[illegible]

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SOUTH FORK OF MUSSELSHELL RIVER NEAR MARTINSDALE, MONT.

This station, which was established June 19, 1907, to determine the amount of water available for irrigation, was located near the ranch of Martin J. Settle, but on April 28, 1908, it was removed upstream about 1½ miles, near the blacksmith shop of the Martinsdale Sheep Company and near the public highway 1¼ miles northeast of Martinsdale.

The South Fork has no important tributaries. Many small ditches are taken from the creek, and during the irrigating season all the water is diverted.

When the new station was established a new datum was used, which has remained unchanged. The bed of the stream is chiefly gravel and is clean and nonshifting. Ice forms during the winter season, but records obtained during the open season are good.

Discharge measurements of South Fork of Musselshell River near Martinsdale, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	J. E. Stewart	40	125	a 2.38	243
July 11	Robert Follansbee	40	108	2.05	187
July 26 b	J. E. Stewart	25	33.0	1.62	101
September 6 b	do	26	18.2	1.18	31.4
October 29 b	do	16	19.7	1.13	30.5
1908.					
April 28	Raymond Richards	39	70.4	1.99	65.0
June 24	J. E. Stewart	39	122	3.28	226
July 28 b	Raymond Richards	16	7.4	1.08	11.2
September 24 b	do	5	1.3	.67	.6

a Gage height somewhat uncertain. b Wading near gage.

Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

[Martin J. Settle and J. G. Wallace, observers.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.							1907.						
1		2.7	1.6	1.25	1.25	1.15	16		2.1	1.3	1.2	1.1	1.0
2		2.5	1.6	1.25	1.2	1.15	17		2.0	1.2	1.2	1.1	1.1
3		2.3	1.9	1.2	1.3	1.15	18		1.9	1.2	1.2	1.2	1.1
4		2.3	1.6	1.2	1.2	1.15	19	1.9	1.9	1.2	1.2	1.1	1.1
5		2.3	1.5	1.2	1.2	1.15	20	2.4	2.0	1.0	1.2	1.1	1.0
6		2.1	1.5	1.2	1.3	1.15	21	2.4	2.0	1.1	.9	1.2	1.
7		2.0	1.5	1.2	1.2	1.15	22	2.3	2.1	1.185	1.1	1.1	1.
8		2.0	1.5	1.2	1.2	1.15	23		2.0	1.195	1.0	1.1	1.
9			1.4	1.2	1.3	1.15	24		1.9	1.1	1.0	1.2	
10		2.15	1.7	1.2	1.3	1.15	25		1.75	1.1	1.0	1.1	
11		2.0	1.7					3.6	1.6	1.1	1.0	1.1	
12		1.9	1.6					3.4	1.55	1.1	1.2	1.2	
13		3.9	1.4					3.1	1.55	1.2	1.2	1.1	
14		2.6	1.4						1.45	1.15	1.2	1.1	
15		2.1	1.4								1.2	1.1	

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Daily gage height, in feet, of South Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	.....	1.85	5.7	2.7	0.8	1.5	1.5	1.9
2	.....	1.85	5.7	2.5	.7	.9	1.6	1.9
3	.....	1.9	5.6	2.4	.7	.9	1.7	1.9
4	.....	1.9	5.8	2.45	.7	.9	1.8	1.9
5	1.05	1.95	5.65	2.3	.7	.8	1.7	1.85
6	1.05	1.95	5.6	2.3	.6	.7	1.7	1.85
7	1.05	2.0	5.8	2.2	.6	.75	1.5	1.85
8	1.05	2.0	5.5	2.0	.5	.75	1.5	1.85
9	1.05	2.5	5.6	1.9	.6	.6	1.7	1.85
10	1.2	2.85	5.5	1.7	.7	.6	1.7	.....
11	1.2	2.85	5.3	1.4	.5	.65	1.6	.....
12	1.3	2.8	5.2	1.35	.4	.6	1.5	.....
13	1.2	2.75	5.0	1.3	.5	.5	1.5	.....
14	1.2	2.65	4.8	1.2	.5	.55	1.45	.....
15	1.2	2.75	4.6	.8	.5	.55	1.6	.....
16	1.3	2.8	4.5	.7	.9	.65	1.7	.....
17	1.4	2.8	4.4	.7	.9	.65	1.9	1.85
18	1.5	2.75	4.4	.7	.9	.7	1.8	1.9
19	1.55	2.65	4.5	.7	1.1	.7	1.75	1.8
20	1.6	2.6	4.0	.7	1.0	.7	1.8	1.85
21	1.6	2.6	3.8	.7	1.0	.75	1.7	1.85
22	1.7	2.5	3.7	.7	1.2	.55	1.65	1.5
23	1.9	2.5	3.5	.8	1.1	.65	1.65	1.5
24	1.9	2.55	3.4	.8	1.0	.65	1.8	1.55
25	1.8	2.6	3.2	1.0	.9	.7	1.8	1.55
26	1.6	2.8	3.2	1.15	.9	.7	1.8	.....
27	1.6	3.75	3.5	1.15	.9	.75	1.8	.....
28	2.0	4.15	3.0	1.15	.8	.75	1.85	.....
29	1.95	4.4	2.85	1.0	1.0	1.0	1.85	.....
30	1.95	4.4	2.75	.9	1.0	2.0	1.9	.....
31	.....	5.35	.....	.9	1.0	.....	1.8	.....

NOTE.—Observer unable to get to gage June 22–25, 1907, because of high water. New gage installed April 28, 1908. New gage heights not comparable with old. Ice conditions latter part of November–December 21, 1907, and November 10–December 31, 1908.

Rating tables for South Fork of Musselshell River near Martinsdale, Mont.

JUNE 19, 1907, TO APRIL 27, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	7	1.60	96	2.30	229	3.00	381
1.00	15	1.70	113	2.40	250	3.10	404
1.10	25	1.80	131	2.50	271	3.20	428
1.20	38	1.90	150	2.60	292	3.30	452
1.30	51	2.00	169	2.70	314	3.40	477
1.40	65	2.10	189	2.80	336	3.50	502
1.50	80	2.20	209	2.90	358	3.60	527

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1907, and is well defined between gage heights 1.6 foot and 2.5 feet.

APRIL 28 TO NOVEMBER 10, 1908.

0.20	0	1.70	43	2.90	170	4.30	369
.40	0.5	1.80	50	3.00	184	4.40	429
.70	1	1.90	56	3.10	199	4.50	472
.80	3	2.00	66	3.20	214	4.60	517
.90	5	2.10	75	3.30	230	4.70	564
1.00	8	2.20	85	3.40	246	5.25	612
1.20	11	2.30	95	3.50	262	5.40	664
1.30	15	2.40	106	3.60	280	5.50	714
1.40	20	2.50	118	3.70	297	5.65	768
1.50	26	2.60	130	3.80	315		
1.60	33	2.70	143	3.90	333		
1.70	41	2.80	156	4.00	351		

is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908, and is well defined between gage heights 1.6 foot and 3.5 feet.

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Monthly discharge of South Fork of Musselshell River near Martinsdale, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
June (9 days)	527	150	318	5,680	A.
July	314	88	168	10,000	A.
August	150	15	58.5	3,600	B.
September	44	7	34.3	2,040	B.
October	* 51	26	34.2	2,100	B.
November	32	20	25.6	1,520	C.
1908.					
April 5–30	150	20	67.0	3,460	B.
May	651	54	168	10,300	A.
June	768	150	483	28,700	B.
July	143	1	34.9	2,150	B.
August	15	0	4.11	253	D.
September	66	0	4.78	284	D.
October	58	27	43.1	2,650	B.
November 1–9	58	54	55.8	996	B.
The period				48,800	

AMERICAN FORK NEAR HARLOWTON, MONT.

American Fork rises in the Crazy Mountains and flows northeastward to its junction with the Musselshell, a few miles below the gaging station, which was established July 28, 1907, at the Shaw & Elliot ranch, 5 miles southeast of Harlowton, Mont., to determine the amount of water available for irrigation and storage.

American Fork has no important tributaries, but receives its water supply from the melting snow on the mountains. The basin of this stream affords some good storage sites, and by holding back the spring flood waters much more land can be put under irrigation.

Records obtained during the open season are good. The bed of the stream at the gaging station is composed of sand and clay, and shifts only under extreme conditions.

Discharge measurements of American Fork near Harlowton, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 28	J. E. Stewart	14	12.2	1.79	23
September 6	do	11	6.4	1.50	2
October 31	do	10	7.3	1.56	3
1908.					
April 28	Raymond Richards	5.5	2.2	1.46	a 2
June 5	do	36	125	3.68	503
June 30	J. E. Stewart	32	71.2	2.38	2
October 24	Raymond Richards	2	.45	1.51	
November 28	do				(b)

[illegible] ling. b Stream dry.

[illegible] were made at various sections.

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Daily gage height, in feet, of American Fork near Harlowton, Mont., for 1907 and 1908.

[Samuel A. Shaw, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907							1907.						
1	.....	1.85	1.5	1.5	1.55	1.55	16	.....	1.6	1.55	1.55	1.55	.....
2	.....	1.75	1.55	1.5	1.55	1.55	17	.....	1.6	1.5	1.55	1.55	.....
3	.....	1.85	1.5	1.5	1.55	1.55	18	.....	1.55	1.5	1.55	1.55	.....
4	.....	1.8	1.5	1.5	1.55	1.55	19	.....	1.55	1.5	1.55	1.55	.....
5	.....	1.65	1.5	1.5	1.55	1.55	20	.....	1.5	1.5	1.5	1.55	.....
6	.....	1.6	1.5	1.5	1.55	1.55	21	.....	1.5	1.5	1.5	1.55	.....
7	.....	1.6	1.5	1.5	1.55	1.55	22	.....	1.5	1.5	1.55	1.55	.....
8	.....	1.5	1.55	1.5	1.55	1.55	23	.....	1.5	1.5	1.6	1.55	.....
9	.....	1.5	1.55	1.5	1.55	.....	24	.....	1.5	1.5	1.6	1.55	.....
10	.....	1.8	1.5	1.5	1.55	.....	25	.....	1.5	1.5	1.55	1.55	.....
11	.....	2.0	1.55	1.5	1.55	.....	26	.....	1.5	1.5	1.55	1.55	.....
12	.....	1.8	1.65	1.5	1.55	.....	27	.....	1.5	1.5	1.6	1.55	.....
13	.....	1.8	1.65	1.5	1.55	.....	28	1.8	1.5	1.5	1.6	1.55	.....
14	.....	1.7	1.6	1.5	1.55	.....	29	1.75	1.5	1.5	1.6	1.55	.....
15	.....	1.65	1.55	1.55	1.55	.....	30	1.9	1.5	1.5	1.6	1.55	.....
							31	1.95	1.6	.....	1.6	.....	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	1.5	1.45	4.4	2.1	.....	.....	1.5	1.75
2	1.5	1.45	4.15	2.0	.....	.....	1.5	1.7
3	1.5	1.45	3.9	2.0	.....	.....	1.5	1.7
4	1.5	1.45	4.15	2.0	.....	.....	1.7	1.7
5	1.5	1.45	3.78	2.0	.....	.....	1.8	1.7
6	1.5	1.45	3.55	2.0	.....	.....	1.8	1.7
7	1.5	1.4	3.38	2.0	.....	.....	1.8	1.7
8	1.5	1.4	3.32	2.0	.....	.....	1.7	1.7
9	1.5	1.4	3.4	1.75	.....	.....	1.7	1.7
10	1.5	1.5	3.32	1.7	.....	.....	1.6	1.7
11	1.5	1.5	3.3	1.65	.....	.....	1.6	1.7
12	1.5	1.5	3.32	1.65	.....	.....	1.6	1.7
13	1.5	1.45	3.3	1.6	.....	.....	1.65	.....
14	1.5	1.45	3.12	1.6	.....	.....	1.65	.....
15	1.5	1.45	3.0	1.6	.....	.....	1.7	.....
16	1.5	1.45	3.05	1.5	.....	.....	1.7	.....
17	1.5	1.4	3.0	1.6	.....	.....	1.75	.....
18	1.45	1.4	2.9	1.6	.....	.....	1.75	.....
19	1.45	1.4	2.8	1.65	.....	.....	1.8	.....
20	1.45	1.45	2.8	1.65	.....	.....	1.8	.....
21	1.45	1.45	2.6	1.66	.....	.....	1.8	.....
22	1.45	1.45	2.5	1.5	.....	.....	1.8	.....
23	1.45	1.45	2.4	1.5	.....	.....	1.8	.....
24	1.45	1.45	2.2	1.5	.....	.....	1.8	.....
25	1.45	1.45	2.2	1.5	.....	.....	1.8	.....
26	1.5	1.45	2.15	1.55	.....	.....	1.8	.....
27	1.5	2.72	2.1	1.55	.....	.....	1.8	.....
28	1.5	2.48	2.2	1.5	.....	.....	1.8	.....
29	1.5	2.48	2.2	1.5	.....	.....	1.8	.....
30	1.5	2.78	2.2	1.5	.....	.....	1.75	.....
31	.....	3.75	.....	1.5	.....	.....	1.75	.....

NOTE.—Ice conditions December 9–31, 1907, January 1–March 31, 1908, and November 13–December 31, 1908. No flow August and September, 1908.

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Rating tables for American Fork near Harlowton, Mont.

JULY 28 TO DECEMBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	1.5	1.70	14	1.90	32	2.00	42
1.60	6.6	1.80	22.5				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and is not well defined.

APRIL 1 TO MAY 26, 1908.

1.40	1.0	1.50	4.3				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and is not well defined.

MAY 27 TO DECEMBER 31, 1908.

1.50	0.2	2.30	66	3.10	256	3.90	615
1.60	4.0	2.40	78	3.20	295	4.00	665
1.70	11	2.50	92	3.30	336	4.10	715
1.80	19	2.60	109	3.40	379	4.20	765
1.90	27	2.70	130	3.50	424	4.30	815
2.00	36	2.80	155	3.60	470	4.40	870
2.10	45	2.90	185	3.70	517		
2.20	55	3.00	219	3.80	565		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and the form of the previous curves and is not well defined.

Monthly discharge of American Fork near Harlowton, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet)
	Maximum.	Minimum.	Mean.	
1907.				
August	42.0	1.5	9.50	
September	10.3	1.5	2.76	
October	6.6	1.5	3.30	
November	4.0	4.0	4.00	
December 1–8	4.0	4.0	4.00	
1908.				
April	4.3	2.6	3.85	
May	541	1.0	34.4	
June	870	45	284	
July	45	.2	12.5	
August	0	0	0	
September	0	0	0	
October	19	.2	13.2	
November 1–12	15	11	11.3	
The period				

NOTE.—Owing to the shifting character of the stream bed, these estimates of monthly flow are merely approximate.

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LEBO CREEK NEAR HARLOWTON, MONT.

Lebo Creek rises at an elevation of 5,600 feet, flows northeastward, and enters American Fork one-half mile below the gaging station. It is about 20 miles long, is fed by springs, and its flow is nearly uniform. Its water is used for irrigation.

The gaging station, which was established July 28, 1907, to determine the amount of water available for irrigation, is located near the Shaw & Elliott ranch, 5 miles southeast of Harlowton.

Records obtained are fair. The flow is affected by grass in the stream bed.

Discharge measurements of Lebo Creek near Harlowton, Mont., in 1906, 1907, and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 11	O. F. Wasmansdorf				a 11.6
1907.					
July 28	J. E. Stewart	10	9.5	1.30	16.5
September 6	do	10	12.6	1.46	18.8
October 31	do	10	9.7	1.26	20.2
1908.					
April 25	Raymond Richards	7.5	8.0	1.08	14.1
June 5	do	10	14.4	1.97	33.5
June 23	J. E. Stewart	10	10.0	1.26	27.7
July 27	Raymond Richards	8	4.2	.73	8.8
September 24	do	8	2.4	.74	10.2

a Weir measurement.

NOTE.—The above measurements, except that for November 11, 1906, were made by wading at various sections.

Daily gage height, in feet, of Lebo Creek near Harlowton, Mont., for 1907 and 1908.

[Samuel A. Shaw, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.							1907.						
1		1.6	1.5	1.5	1.4	1.35	16		1.6	1.55	1.4	1.4	
2		1.5	1.5	1.5	1.4	1.35	17		1.5	1.5	1.4	1.4	
3		1.55	1.5	1.6	1.4	1.35	18		1.45	1.50	1.4	1.45	
4		1.4	1.5	1.5	1.4	1.35	19		1.4	1.55	1.4	1.46	
5		1.35	1.5	1.5	1.4	1.35	20		1.4	1.5	1.35	1.4	
6		1.3	1.5	1.5	1.4	1.35	21		1.35	1.5	1.35	1.4	
7		1.3	1.5	1.5	1.4	1.35	22		1.3	1.5	1.35	1.35	
8		1.1	1.5	1.5	1.4	1.35	23		1.2	1.5	1.4	1.35	
9		1.2	1.5	1.5	1.4		24		1.2	1.5	1.4	1.35	
10		1.0	1.5	1.5	1.4		25		1.2	1.5	1.4	1.35	
11		1.0	1.5	1.5	1.4		26		1.2	1.5	1.4	1.35	
12		1.6	1.4	1.5	1.4		27		1.2	1.5	1.4	1.35	
13		1.75	1.7	1.4	1.4		28	1.4	1.3	1.5	1.4	1.35	
14		1.6	1.4	1.4	1.4		29	1.35	1.3	1.55	1.4	1.36	
15		1.6	1.4	1.4	1.4		30	1.35	1.3	1.55	1.4	1.35	
							31	1.35	1.5		1.4		

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Daily gage height, in feet, of Lebo Creek near Harlowton, Mont., for 1907 and 1908—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.								
1	1.10	0.95	3.18	0.90	0.30	0.70	0.70	1.3
2	1.10	.95	2.35	.80	.30	.70	.70	1.3
3	1.10	1.0	2.1	.80	.30	.70	.70	1.3
4	1.05	1.0	2.4	.90	.30	.70	.80	1.3
5	1.05	1.0	2.05	.90	.30	.70	1.0	1.3
6	1.05	1.0	1.8	.90	.30	.70	1.0	1.3
7	1.05	.90	1.7	.80	.30	.70	1.0	1.3
8	1.05	.90	1.75	.80	.30	.70	.90	1.3
9	1.05	.90	1.75	.80	.30	.70	.85	1.3
10	1.05	1.05	1.7	.80	.30	.70	.85	1.3
11	1.05	1.1	1.6	.90	.30	.70	.85	1.3
12	1.05	1.0	1.5	.95	.70	.70	.85	1.3
13	1.05	.95	1.5	.90	.60	.70	.85	.....
14	1.05	.95	1.5	.90	.70	.70	.85	.....
15	1.05	.95	1.45	.80	.80	.70	.80	.....
16	1.05	.95	1.4	.80	.70	.70	.80	.....
17	1.0	.95	1.5	.80	.80	.70	.80	.....
18	1.0	.95	1.5	.80	.80	.70	.80	.....
19	1.0	.95	1.4	.80	.80	.70	.80	.....
20	1.0	1.0	1.5	.80	.75	.70	.80	.....
21	1.0	1.0	1.4	.80	.75	.70	.80	.....
22	1.0	.80	1.4	.80	.75	.70	.80	.....
23	1.0	.80	1.4	.80	.80	.70	1.0	.....
24	1.0	.75	1.3	.80	.80	.70	1.5	.....
25	.95	.75	1.3	.80	.80	.70	1.75	.....
26	1.0	.80	1.2	.75	.75	.70	1.75	.....
27	1.0	2.75	1.2	.75	.75	.70	1.5	.....
28	1.05	1.8	1.1	.75	.70	.70	1.25	.....
29	1.1	1.38	1.1	.70	.70	.70	1.25	.....
30	1.0	1.9	1.0	.60	.70	.70	1.25	.....
31	.....	5.3	.....	.40	.75	.....	1.3	.....

NOTE.—Ice conditions December 9–31, 1907; November 13–December 31, 1908.

MILK RIVER DRAINAGE BASIN.

DESCRIPTION.

Milk River is formed in the southern part of the Canadian Province of Alberta by the union of two streams, the North Fork and the South Fork, that rise in the undulating foothills of the Rocky Mountains in northeastern Montana, near the international boundary line. For about 100 miles from this junction the Milk flows eastward parallel to and on the northeastern side of the boundary; it then turns to the southeast, passes across the northern part of Montana, and discharges into the Missouri east of Glasgow.

The tributaries of Milk River, except Clear Creek near Yantic and North Fork at Chinook, are for the most part intermittent streams but the drainage ways that carry them contain local water pockets which are used as watering places for stock.

From the point at which it leaves Canada and enters Montana to Yantic, 10 miles [illegible] Milk is bounded on both sides by high cliffs that [illegible]. At Yantic the cliffs recede [illegible] spreads out, and

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maintains a width from 3 to 4 miles to its lower end, where it narrows to a mile near Hinsdale. This wider part of the valley was probably the preglacial channel of this Missouri before it was turned aside by the ice sheet and forced to seek a new outlet eastward along the southern face of the glacier.

From the top of the cliffs the country has a rolling aspect, exhibiting no abrupt changes except where tributaries to the main river have eroded deep channels in passing from higher or bench lands to the valley. The general slope of the country is toward the east.

A deposit of glacial drift, varying from a layer so thin as to be unnoticeable to a bed 70 feet thick, covers the greater part of the drainage basin except along the streams, and many small ponds that dry up in summer time are scattered over the area. Most of these ponds occupy shallow depressions with no outlet, and their waters as a rule contain salts leached from the soil, and are therefore alkaline. Highly alkaline water was also obtained by a number of wells that have been sunk in the vicinity of Havre and Chinook.

The entire drainage basin lies within the plains section and is treeless except for a few willows and cottonwoods along the stream.

The mean annual rainfall, which is about 14 inches at Havre, is 19 inches at the extreme western edge of the basin. As a rule most of this rainfall occurs during the months of May and June. As might be expected in this northern latitude, the streams and lakes are icebound from the last part of November to the first of April.

As the rainfall is so scanty, irrigation is necessary for successful cultivation of crops. The United States Reclamation Service has begun construction on an irrigation project that will store the flood water of Milk River, reinforce the discharge by water from St. Mary River, and ultimately reclaim 250,000 acres of land in the lower valley.

Reservoirs for the storage of flood waters are possible at a number of places in the basin, as at Chain Lakes, 30 miles northwest of Havre, and Mud Lake, in Tps. 31 and 32 N., Rs. 31 and 32 E., and at Lake Bourdoin and Lonesome Lake.

Natural power opportunities are wholly lacking in the basin, for the fall of none of the streams is large, and Milk River itself is apt to cease to flow in the late summer and autumn.

The longest run-off record extends back to 1891. The wettest year since that time was 1909 and the driest was 1910. The run-off of the river in the driest year was only one-fourteenth of that of the wettest.

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The following gaging stations have been maintained in this river basin:

South Fork of Milk River near Browning, Mont., 1905–1908.
Milk River at Havre, Mont., 1898–1908.
Milk River at Chinook, Mont., 1897.
Milk River at Malta, Mont., 1902–1908.
Milk River at Hinsdale, Mont., 1908.
West Fork of Milk River at Chinook, Mont., 1906–1908.
North Fork of Milk River near Chinook, Mont., 1906–1908.
Beaver Creek near Ashfield, Mont., 1903–1906 and 1908.
Rock Creek near Hinsdale, Mont., 1905–7.
Porcupine Creek near Nashua, Mont., 1908.

SOUTH FORK OF MILK RIVER NEAR BROWNING, MONT.

This station, which is located at Richard Croff's ranch, about 40 miles northeast of Browning, Mont., and about 6 miles south of the Canadian boundary line, was established April 28, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used above this station. A number of small ditches divert water to irrigate meadow lands in the river bottom, a considerable amount of this water returning to the stream as seepage and waste water.

The river overflows its banks at a gage height of 12 feet. During the high water of June, 1908, the gage was washed out and was not replaced until July 31, 1908. From high-water marks the stage was found to be 15.4 feet. The flood width was 850 feet and the flood cross section about 2,600 square feet.

On July 31 a new gage and cable were put in at their original locations. The datum of the gage remains the same.

The results are excellent except during the winter months, when they are affected by ice.

Discharge measurements of South Fork of Milk River near Browning, Mont., for 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft*
May 17	J. C. Stewart	58	157	5.29	442
June 8	J. R. Pierson	57	170	5.65	546
September 8	Fallansbee and Pierson	42	42.6	3.66	50
1908.					
July 31 *	Stewart and Hinds	46	63.3	3.13	7
August 29	do	28	43.1	2.90	4
October	do	55	58.5	3.2	7

* Made by wading.

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Daily gage height, in feet, of South Fork of Milk River near Browning, Mont., for 1907 and 1908.

[R. J. Croff, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.								
1	.....	4.28	4.65	4.62	3.70	3.90	3.80	3.65
2	.....	4.28	4.80	4.52	3.72	3.78	3.75	3.65
3	.....	4.35	4.75	4.48	3.80	3.72	3.75	3.65
4	.....	4.42	4.72	4.48	3.75	3.68	3.75	3.65
5	.....	4.42	4.60	4.42	3.72	3.65	3.70	3.65
6	.....	4.50	4.52	4.35	3.70	3.62	3.70	3.65
7	.....	4.52	4.88	4.28	3.75	3.75	3.78	3.65
8	.....	5.08	5.60	4.25	3.75	3.62	3.80	3.65
9	5.05	5.88	5.25	4.32	3.75	3.65	3.75	3.65
10	4.95	5.28	4.75	4.30	3.75	3.65	3.78	3.65
11	4.85	5.22	4.62	4.25	3.70	3.82	3.70	3.58
12	4.75	5.32	4.60	4.22	3.70	3.88	3.70	3.55
13	4.68	4.82	4.62	4.20	3.75	3.92	3.70	3.42
14	4.72	4.60	4.55	4.25	3.70	3.98	3.70	3.42
15	4.70	4.72	4.42	4.30	3.78	4.05	3.65	3.58
16	4.55	5.00	4.52	4.42	3.75	4.25	3.65	3.65
17	4.40	5.38	4.50	4.35	3.70	4.75	3.65	3.65
18	4.32	5.25	4.38	4.25	3.65	4.68	3.65	3.45
19	4.20	4.98	4.30	4.18	3.62	4.22	3.65	3.45
20	4.10	4.95	4.30	4.12	3.65	4.22	3.65	3.65
21	4.32	4.92	4.42	4.10	3.62	4.15	3.65	3.65
22	4.30	4.78	7.90	4.18	3.60	4.05	3.65	3.65
23	4.50	4.72	8.45	4.12	3.62	3.88	3.65	3.65
24	4.32	4.75	6.32	4.05	3.55	3.82	3.65	.....
25	4.20	4.62	5.35	3.98	3.52	3.85	3.65	.....
26	4.18	4.52	4.98	3.92	3.58	3.80	3.65	.....
27	4.05	4.45	4.90	3.88	3.65	3.82	3.65	.....
28	3.75	4.50	4.82	3.90	3.78	3.78	3.65	.....
29	4.02	4.70	4.68	3.78	3.80	3.80	3.65	.....
30	4.28	4.68	4.60	3.72	3.82	3.72	3.65	.....
31	.....	4.70	.....	3.75	3.92	.....	3.65	.....
1908.								
1	6.05	4.10	7.55	.....	3.20	2.90	3.40	3.45
2	5.88	4.15	7.40	.....	3.20	2.90	3.40	3.50
3	6.05	4.12	5.90	.....	3.20	2.90	3.30	3.40
4	6.10	4.18	8.55	.....	3.20	2.90	3.30	3.40
5	5.98	4.32	10.45	.....	3.20	2.80	3.55	3.40
6	5.85	4.12	(a)	.....	3.20	2.80	3.70	3.40
7	5.72	4.15	.....	.....	3.20	2.80	3.60	3.30
8	5.80	4.18	.....	.....	3.20	2.80	3.60	3.20
9	5.82	4.25	.....	.....	3.20	2.80	3.50	3.20
10	5.72	4.50	.....	.....	3.20	2.80	3.40	3.20
11	5.62	4.40	.....	.....	3.20	2.75	3.35	3.10
12	5.60	4.75	.....	.....	3.20	2.70	3.30	3.10
13	5.52	4.95	.....	.....	3.20	2.70	3.10	3.10
14	5.48	5.10	.....	.....	3.20	2.70	3.00	3.20
15	5.95	5.65	.....	.....	3.20	2.70	3.10	3.20
16	4.88	5.60	.....	.....	3.20	2.70	3.10	3.20
17	4.80	4.65	.....	.....	3.10	2.80	3.10	3.20
18	4.62	4.45	.....	.....	3.10	2.90	3.10	3.30
19	4.58	4.35	.....	.....	3.10	3.05	3.00	3.50
20	4.50	4.50	.....	.....	3.10	3.00	2.90	3.50
21	4.42	4.45	.....	.....	3.10	2.90	2.90	3.50
22	4.30	4.50	.....	.....	3.10	2.90	2.90	3.50
23	5.22	4.40	.....	.....	3.10	2.90	3.00	3.50
24	4.15	4.35	.....	.....	3.10	3.00	3.00	3.50
25	4.00	4.45	.....	.....	3.10	2.90	3.00	3.50
26	4.00	5.30	.....	.....	3.10	2.90	3.00	3.40
27	4.20	5.70	.....	.....	3.10	3.00	3.05	3.40
28	4.22	5.65	.....	.....	3.10	3.40	3.10	3.30
29	4.22	4.90	.....	.....	3.05	3.70	3.15	3.30
30	4.15	4.75	.....	.....	2.90	3.50	3.20	3.30
31	.....	5.35	.....	.....	2.90	.....	3.30	.....

[a] Gage washed out June 6, 1908. Maximum high-water gage height for June 6, 1908, as determined from high-water marks was 15.4 feet.

NOTE.—Ice conditions November 24 to December 31, 1907, and December, 1908.

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Rating tables for South Fork of Milk River near Browning, Mont.

JANUARY 1, 1907, TO JUNE 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	20	4.60	245	5.80	597	7.00	1,010
3.50	28	4.70	272	5.90	629	7.20	1,090
3.60	40	4.80	299	6.00	662	7.40	1,175
3.70	53	4.90	327	6.10	695	7.60	1,265
3.80	68	5.00	355	6.20	728	7.80	1,360
3.90	85	5.10	384	6.30	762	8.00	1,460
4.00	104	5.20	413	6.40	796	8.20	1,560
4.10	125	5.30	443	6.50	831	8.40	1,665
4.20	147	5.40	473	6.60	866	8.60	1,775
4.30	170	5.50	503	6.70	901		
4.40	194	5.60	534	6.80	937		
4.50	219	5.70	565	6.90	973		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1906–7. It is well defined between gage heights 3.2 feet and 6.0 feet.

JULY 31, 1908, TO NOVEMBER 30, 1908.

2.70	25	3.00	52	3.30	96	3.60	153
2.80	32	3.10	65	3.40	113	3.70	176
2.90	41	3.20	80	3.50	132		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is fairly well defined.

Monthly discharge of South Fork of Milk River near Browning, Mont., for 1907 and 1908.

[Drainage area 283 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April 9–30	370	60	67.0	0.272	0.22	2,920	A.
May	623	165	301	1.06	1.22	18,500	A.
June	1,690	170	378	1.34	1.50	22,500	A.
July	250	56	148	.523	.60	9,100	A.
August	89	30	54.6	.193	.22	3,360	A.
September	286	43	93.9	.332	.37	5,590	A.
October	68	46	51.8	.183	.21	3,190	A.
November 1–23	46	22	40.8	.144	.12	1,860	A.
The period						67,000	
1908.							
April	695	104	402	1.42	1.58	23,900	A.
May	565	125	267	.943	1.09	16,400	A.
August	80	41	71.0	.251	.29	4,370	A.
September	176	25	47.1	.166	.19	2,800	B.
October	170	41	84.5	.299	.34	5,200	A.
November	132	65	103	.364	.41	6,130	B.
The period						58,800	

MILK RIVER AT HAVRE, MONT.

This station, which is located at the highway bridge over Milk River at Havre, [illegible] was established May 15, 1898, to obtain data for use in connection with a storage project for irrigation in

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Milk River valley. The nearest important tributaries enter about 20 miles east of the station.

The drainage area above Havre is about 7,300 miles, but the entire run-off from this area does not pass Havre, as an elaborate canal system in southern Alberta is supplied by Milk River. The theoretical discharge of the main canal of this system is about 330 second-feet of the low-water flow and 1,500 second-feet of the high-water discharge. As the system has not been wholly in operation the full effect of the diversions on the flow of Milk River has not yet been felt at Havre.

There are no other important irrigation rights above Havre, but farther downstream are five large canal systems supplied directly from Milk River and irrigating about 22,000 acres. The water rights of these various systems have not yet been adjudicated although preliminary steps have been taken. A suit in behalf of the Fort Belknap Indians was decided in their favor, with the result that they were given a prior right over the other canals to 125 second-feet, the priority of the other rights not being touched upon. Although no provision for storage has been made by the above claimants, the entire unappropriated flow of the stream has been filed upon by the United States Reclamation Service in connection with its Milk River irrigation project, which is now under construction.

The gage datum has not been changed since the station was established. From the last part of November to the first part of April the river at Havre is frozen entirely over and in portions of the cross sections it is usually frozen to the bottom.

Frequent discharge measurements are necessary at this station, and even with these the estimates are subject to considerable error. This characteristic is true of the entire river. In dry years the flow ceases entirely and the water stands in pools for several months.

Discharge measurements of Milk River at Havre, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 2	Follansbee and Pierson	117	370	5.75	993
[illegible]	do	121	415	5.93	1,170
April 5	do	178	1,270	9.72	3,520
Do	do	173	1,130	9.35	3,100
April 6	J. B. Pierson	166	1,150	9.04	2,910
April 12	do	160	432	6.30	1,300
April 19	do	124	294	5.16	622
April 25	do	126	230	4.60	356
May 4	do	123	209	4.27	300
May 15	do	136	271	4.96	601
May 21	Robert Follansbee	145	354	5.13	765
May 22	J. B. Pierson	116	215	4.94	650
May 27	do	130	290	4.79	487
May 31	do	122	255	4.53	437
June 15	do	137	313	4.75	554
June 24	do	161	537	6.05	1,200
June 26	do	160	1,050	8.29	2,900
June 27	Follansbee and Pierson	140	450	5.75	1,270
July 16	J. B. Pierson	142	220	4.45	404
July 18	do	114	174	4.25	290

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Discharge measurements of Milk River at Havre, Mont., in 1907 and 1908—Continued.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 2	J. B. Pierson	105	111	3.57	128
August 22 [a]	do	40	48.5	3.19	57
August 29 [a]	do		43.7	3.07	42
September 12	do	95	68	3.44	92
September 26	Robert Follansbee	112	148	3.93	197
October 19	Follansbee and Stewart	90	75	3.32	67
1908.					
April 4	Stewart and Huch	105	150	4.20	222
Do	do	119	176	4.35	260
April 25	A. F. Huch	104	188	4.39	348
May 22	do	106	257	4.70	478
June 4	do	149	293	5.11	571
June 27	do	137	324	5.16	840
August 5	do	70	111	4.01	204
October 27 [a]	do	63	90.5	3.97	144

[a] Made by wading.

Daily gage height, in feet, of Milk River at Havre, Mont., for 1907 and 1908.

[L. H. Ling, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	5.4	5.55	4.3	4.5	5.4	3.5	3.1	3.7	3.2	3.4
2	.....	.....	5.8	4.3	4.4	5.0	3.5	3.1	3.65	3.2	3.45
3	.....	.....	7.4	4.3	4.4	4.9	3.4	3.1	3.6	3.25	3.45
4	.....	5.4	8.35	4.2	4.35	4.8	3.5	3.2	3.45	3.25	.....
5	.....	.....	9.93	4.1	4.4	4.7	3.4	3.25	3.5	3.25	.....
6	.....	.....	8.94	4.1	4.4	4.7	3.3	3.0	3.35	3.25	.....
7	.....	.....	8.2	4.2	4.4	4.6	3.4	3.35	3.4	3.25	.....
8	.....	.....	7.7	4.3	4.5	4.6	3.4	3.35	3.35	3.3	.....
9	.....	5.5	8.3	4.4	4.7	4.6	3.2	3.35	3.45	3.3	.....
10	3.4	.....	7.7	4.6	4.6	4.6	3.3	3.4	3.35	3.1	.....
11	3.8	.....	7.7	4.2	4.5	4.6	3.2	3.4	3.4	3.15	.....
12	4.9	.....	6.3	4.2	4.4	4.5	3.1	3.4	3.35	3.15	.....
13	4.5	.....	6.7	5.3	4.4	4.5	3.2	3.5	3.4	3.15	.....
14	4.4	.....	6.6	4.9	4.4	4.5	3.2	3.65	3.35	3.2	.....
15	8.0	.....	5.9	4.8	4.7	4.4	3.1	3.8	3.3	3.2	.....
16	7.5	.....	5.5	4.9	4.7	4.65	3.1	3.9	3.35	3.15	.....
17	7.7	.....	5.4	4.9	4.4	4.4	3.1	3.8	3.3	3.15	.....
18	7.5	.....	5.2	4.7	4.4	4.2	3.0	3.75	3.25	3.15	.....
19	7.5	.....	5.0	4.7	4.4	4.2	3.1	3.7	3.25	3.25	.....
20	7.2	.....	4.9	4.5	4.3	4.1	3.0	3.6	3.25	3.35	.....
21	7.3	6.6	4.7	5.0	4.2	4.1	3.1	3.5	3.25	3.45	.....
22	7.2	7.8	4.5	5.1	4.2	4.0	3.1	3.65	3.25	3.4	.....
23	7.3	6.8	4.5	4.9	9.9	4.3	3.1	3.7	3.25	3.4	.....
24	7.2	10.1	4.6	4.9	6.4	4.1	3.05	4.25	3.25	3.4	.....
25	7.3	8.5	4.5	4.95	6.7	4.0	3.05	4.05	3.25	3.4	.....
26	.....	6.2	4.4	4.9	8.9	3.9	3.05	4.0	3.25	3.4	.....
27	.....	6.0	4.4	4.8	6.85	3.8	3.0	3.85	3.2	3.4	.....
28	.....	5.4	4.3	4.7	6.0	3.8	3.0	3.8	3.2	3.4	.....
29	.....	5.9	4.3	4.5	5.8	3.7	3.0	3.8	3.2	3.4	.....
30	.....	5.3	4.6	4.6	5.8	3.7	3.1	3.7	3.2	3.4	.....
31	.....	5.6	.....	4.5	.....	3.6	3.15	.....	3.2	.....	.....
1908.											
1	.....	.....	.....	4.2	5.6	5.1	4.1	3.95	3.95	4.5	.....
2	.....	.....	.....	4.2	5.0	5.1	4.1	3.85	4.0	4.45	.....
3	.....	.....	4.1	4.1	5.0	5.1	4.0	3.85	4.1	4.45	.....
4	.....	.....	4.3	4.05	7.4	5.0	4.0	3.8	4.2	4.40	.....
5	.....	.....	4.7	4.0	7.0	4.98	4.0	3.76	4.3	4.7	.....
6	.....	4.1	5.0	3.9	[illegible]	[illegible]	[illegible]	3.75	4.35	4.65	.....
7	.....	.....	4.7	3.9	[illegible]	[illegible]	[illegible]	3.76	4.3	4.6	.....
8	.....	.....	4.6	3.9	[illegible]	[illegible]	[illegible]	3.75	4.3	4.5	.....
9	.....	4.1	4.9	3.9	[illegible]	[illegible]	[illegible]	3.73	4.2	4.4	.....
10	.....	4.2	4.7	3.9	[illegible]	[illegible]	[illegible]	3.7	4.2	4.3	.....

[a] Maximum [illegible]

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Daily gage height, in feet, of Milk River at Havre, Mont., for 1907 and 1908—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.											
11	.....	4.2	4.5	3.9	9.45	4.8	3.8	3.7	4.2	4.0	.....
12	.....	4.2	4.4	3.9	7.9	4.78	3.8	3.7	4.2	4.0	.....
13	.....	4.4	4.3	3.95	7.2	4.7	3.9	3.7	4.25	.....	.....
14	.....	4.4	4.2	4.0	6.9	4.6	3.9	3.69	4.25	.....	.....
15	.....	4.4	4.1	4.0	6.6	4.5	3.9	3.68	4.3	.....	.....
16	.....	4.1	4.1	4.1	6.4	4.4	3.9	3.68	4.0	.....	.....
17	.....	4.2	4.2	4.5	6.4	4.4	3.95	3.68	3.95	3.9	.....
18	.....	4.2	4.2	4.5	6.2	4.4	3.8	3.68	3.9	3.9	.....
19	.....	4.15	4.1	5.1	5.9	4.4	3.8	3.75	3.9	3.9	.....
20	.....	4.05	4.0	4.95	5.7	4.8	3.9	3.75	3.9	3.9	.....
21	.....	4.2	4.2	4.8	5.6	4.7	3.9	3.75	3.85	4.9	.....
22	.....	4.1	4.2	4.75	5.5	4.6	3.9	3.68	3.82	4.5	.....
23	.....	4.4	4.2	4.5	5.5	4.6	3.9	3.6	3.75	4.4	.....
24	.....	4.0	4.1	4.45	5.45	4.5	3.9	3.62	3.65	4.2	.....
25	.....	3.9	4.1	4.45	5.4	4.5	3.9	3.7	3.65	.....	.....
26	.....	4.2	4.1	4.45	5.2	4.4	3.8	3.85	3.65	.....	.....
27	.....	.....	4.5	4.4	5.2	4.38	3.8	3.85	3.9	.....	.....
28	.....	.....	4.3	4.4	5.1	4.2	3.8	3.85	4.2	.....	.....
29	.....	.....	4.2	4.4	5.1	4.18	3.8	3.9	4.2	4.0	.....
30	.....	.....	4.2	4.45	5.1	4.2	3.8	3.9	4.2	.....	.....
31	.....	.....	.....	5.45	.....	4.2	3.8	.....	4.5	.....	.....

NOTE.—Ice conditions: River frozen to the bottom (no flow) January 1–February 9, 1907. River open February 10–22; frozen from February 23–March 23, and December, 1907–March 13, 1908, November 14–16 and November 25–December 31, 1908.

Daily discharge, in second-feet, of Milk River at Havre, Mont., for 1907 and 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	.....	910	280	430	1,000	110	50	146	42
2	.....	1,100	300	300	740	110	50	126	42
3	.....	2,000	210	240	640	90	50	130	60
4	.....	2,050	250	200	620	110	40	110	60
5	.....	3,500	250	300	500	90	40	120	60
6	.....	2,650	250	280	500	72	40	90	48
7	.....	2,000	240	260	520	60	35	90	48
8	.....	2,130	210	420	500	60	30	90	75
9	.....	2,150	250	510	500	60	35	100	70
10	.....	2,400	420	400	480	72	60	80	60
11	.....	2,440	290	420	460	60	60	80	56
12	.....	1,500	250	360	440	50	60	80	56
13	.....	1,300	240	350	440	60	50	80	56
14	.....	1,000	300	300	600	60	50	80	42
15	.....	900	300	300	500	50	50	70	42
16	.....	800	300	320	480	50	45	80	56
17	.....	740	300	400	500	50	50	70	56
18	.....	650	300	400	500	50	50	60	56
19	.....	650	300	400	500	50	50	60	56
20	.....	600	300	400	500	50	50	60	56
21	.....	600	300	400	500	50	50	60	140
22	.....	600	300	400	500	50	50	60	56
23	.....	600	300	400	500	50	50	60	56
24	.....	600	300	400	500	50	50	60	56
25	.....	600	300	400	500	50	50	60	56
26	.....	600	300	400	500	50	50	60	56
27	.....	600	300	400	500	50	50	60	56
28	.....	600	300	400	500	50	50	60	56
29	.....	600	300	400	500	50	50	60	56
30	.....	600	300	400	500	50	50	60	56
31	.....	600	300	400	500	50	50	60	56

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Daily discharge, in second-feet, of Milk River at Havre, Mont., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
6	.....	450	230	2,150	700	205	130	260	330
7	.....	375	205	4,720	685	205	125	240	315
8	.....	335	205	6,500	630	188	125	240	262
9	.....	485	205	9,600	630	188	120	200	255
10	.....	408	205	7,600	630	188	118	200	200
11	.....	335	205	3,700	610	155	115	200	150
12	.....	320	205	2,500	600	155	115	200	150
13	.....	285	215	2,020	565	188	115	210	.....
14	208	255	230	1,850	515	188	112	240	.....
15	208	230	230	1,660	470	188	110	225	.....
16	208	235	250	1,540	410	188	110	155	.....
17	228	265	395	1,540	410	192	110	145	135
18	228	265	395	1,430	410	155	110	135	135
19	218	235	660	1,260	410	155	125	135	135
20	197	220	585	1,160	585	188	125	135	135
21	228	280	515	1,110	510	188	125	125	135
22	208	280	490	1,050	465	165	110	120	135
23	280	280	395	1,050	465	165	90	110	135
24	190	250	380	1,020	430	165	95	90	135
25	170	250	350	1,000	430	165	108	90	.....
26	228	250	350	840	360	140	135	90	.....
27	.....	390	320	840	350	140	135	135	.....
28	.....	320	320	820	290	140	135	200	.....
29	.....	290	310	820	280	140	145	200	.....
30	.....	290	325	820	290	140	145	200	.....
31	.....	.....	700	.....	290	140	.....	285	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Milk River at Havre, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
February	.....	.....	800	44,000
March	3,750	.....	845	52,000
April	3,500	275	1,210	72,000
May	760	255	458	28,200
June	3,720	325	822	48,900
July	1,000	130	397	24,400
August	110	40	61.6	3,790
September	288	40	127	7,560
October	145	62	81.8	5,030
November	100	50	72.5	4,310
December	.....	.....	60	3,690
The period	3,750	.....	411	294,000
1908.				
March	280	170	212	13,000
April	485	205	285	17,000
May	700	205	330	20,300
June	9,600	600	2,190	130,000
July	810	280	527	32,400
August	230	140	174	10,700
September	150	90	124	7,380
October	285	80	178	10,900
November	200	135	186	11,100
The period	.....	.....	.....	284,000

NOTE.—Discharge estimated for ice periods in February, November, 1908; also for April 1 and 2, 1908.

Owing to the shifting character of the stream bed, the discharge is approximate.

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MILK RIVER AT MALTA, MONT.

This station, which is located at the highway bridge at Malta, Mont., was established July 31, 1902, to obtain data for irrigation projects in Milk River valley. The nearest tributaries above the station are West and North forks of Milk River, which enter about 60 miles west of Malta.

The drainage area above is about 14,000 square miles, but the entire run-off does not pass this station, for between Havre and Malta seven irrigation canals, which irrigate about 25,000 acres of land, divert water from Milk River and its tributaries. The United States Reclamation Service has under construction a diversion dam at Dodson, about 17 miles above the station, which diverts water for the irrigation of about 108,000 acres of land in Milk River valley east of Malta. There are two canals, one on each side, with a total discharge of 1,000 second-feet.

The gage datum has not been changed since the station was established. From November until April the gage heights are affected by ice, so that estimates of run-off are only approximate.

Discharge measurements of Milk River at Malta, Mont., for 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	Sq. ft.	Feet.	Sec.-ft.
April 5	Fahnestock and Pierson	[illegible]	[illegible]	[illegible]	[illegible]
April [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
April 6	J. B. Pierson	[illegible]	[illegible]	[illegible]	[illegible]
April [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
April [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June 3	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	Fahnestock and Horner	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]					
April [illegible]	Horner and Black	[illegible]	[illegible]	[illegible]	[illegible]
April [illegible]	A. P. Black	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	Horner and Black	[illegible]	[illegible]	[illegible]	[illegible]
May [illegible]	A. P. Black	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]
June [illegible]	do	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Footings. [illegible] Measuring. [illegible]

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Daily gage height, in feet, of Milk River at Malta, Mont., for 1907 and 1908.

[M. J. Larson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	19.88	4.50	3.50	5.60	1.90	2.35	2.05	1.72	.....
2	.....	19.45	4.40	3.55	5.05	1.95	1.85	2.00	1.75	.....
3	.....	10.85	4.15	3.50	4.78	1.92	1.70	1.95	1.78	.....
4	.....	14.40	3.80	3.42	4.55	1.90	1.55	1.85	.....	.....
5	.....	17.95	3.45	3.35	4.20	1.80	1.50	1.82	1.80	.....
6	.....	19.45	3.22	3.28	3.92	1.72	1.48	1.80	1.80	.....
7	.....	19.30	3.50	3.20	3.80	1.72	1.42	1.78	.....	.....
8	.....	18.82	3.92	3.15	3.68	1.78	1.40	.....	.....	.....
9	.....	19.02	3.90	3.10	3.52	1.70	.....	1.75	1.70	.....
10	.....	19.75	3.85	3.00	3.38	1.68	1.35	1.75	.....	.....
11	.....	19.48	3.82	3.05	3.35	1.65	.....	.....	1.65	.....
12	.....	18.65	3.75	3.00	3.30	1.62	1.48	1.72	.....	.....
13	.....	17.28	3.80	3.10	3.18	.....	1.55	1.72	1.60	.....
14	.....	14.10	3.95	3.25	3.05	1.58	1.60	1.70	.....	.....
15	.....	11.55	4.10	3.30	3.12	.....	1.70	1.70	1.58	.....
16	.....	11.20	4.20	3.78	3.22	1.50	1.72	1.70	1.58	.....
17	.....	11.80	4.22	4.30	3.35	.....	1.78	1.68	1.52	.....
18	.....	11.32	4.10	4.10	3.15	1.45	1.80	.....	1.52	.....
19	.....	9.95	3.95	3.78	3.08	1.42	1.75	1.70	.....	.....
20	.....	9.00	3.90	3.45	3.02	1.55	1.80	.....	1.50	.....
21	.....	9.00	3.88	3.40	2.90	1.58	1.85	1.70	.....	.....
22	.....	7.50	3.82	3.20	2.85	1.52	1.90	1.70	1.50	.....
23	.....	8.75	3.90	3.25	2.75	1.45	.....	.....	.....	.....
24	.....	9.65	4.20	5.60	2.68	.....	1.88	1.68	1.50	.....
25	13.98	10.88	5.35	8.08	2.60	1.40	1.80	.....	.....	.....
26	13.45	10.18	5.30	11.18	2.52	1.40	1.75	1.65	1.48	.....
27	12.00	9.45	5.25	9.05	2.50	1.38	1.82	.....	.....	.....
28	11.45	7.62	4.90	8.20	2.45	1.35	1.90	1.68	1.48	.....
29	11.10	5.20	4.52	7.30	2.35	1.35	2.02	.....	.....	.....
30	20.90	5.08	4.20	6.48	2.28	1.45	2.05	1.70	1.45	.....
31	21.35	.....	3.90	.....	2.15	2.50	.....	1.72	.....	.....
1908.										
1	.....	.....	1.50	2.50	3.22	1.92	1.75	1.55	1.90	1.85
2	.....	.....	1.48	2.60	3.15	1.82	1.78	1.50	1.95	1.90
3	.....	.....	1.48	2.72	3.05	1.70	1.75	1.58	2.00	1.98
4	.....	.....	1.50	2.85	2.88	1.55	1.70	1.55	2.05	.....
5	.....	.....	1.50	3.12	2.75	1.70	1.68	1.60	2.10	1.90
6	.....	.....	1.50	3.48	2.68	1.75	1.68	1.65	2.12	.....
7	.....	.....	1.50	4.15	2.60	1.72	1.70	1.72	2.20	1.80
8	.....	2.68	1.48	4.55	2.45	1.75	1.70	1.72	2.22	.....
9	.....	2.82	1.45	6.42	2.32	1.72	1.68	1.80	.....	1.62
10	.....	3.05	1.40	8.25	2.30	1.72	1.65	1.85	2.20	.....
11	.....	3.08	1.38	9.68	2.22	1.70	1.60	1.90	2.18	.....
12	.....	3.02	1.30	10.95	2.18	1.72	1.55	1.95	2.18	1.48
13	.....	2.90	1.30	a 12.08	2.08	1.70	1.50	.....	2.15	.....
14	.....	2.75	1.28	11.32	2.00	1.70	1.50	1.95	2.18	1.40
15	.....	2.62	1.25	8.42	2.00	1.70	1.52	1.92	2.18	.....
16	.....	2.50	1.20	6.85	1.98	1.68	1.50	1.95	2.18	1.58
17	.....	2.38	1.18	6.60	1.98	1.62	1.50	1.98	2.15	1.70
18	.....	2.12	1.15	6.28	1.92	1.55	1.52	1.98	.....	.....
19	.....	2.02	1.12	6.05	1.92	1.52	1.50	2.00	2.15	.....
20	.....	1.92	1.10	5.75	1.90	1.52	1.50	.....	.....	1.75
21	.....	2.35	1.45	5.15	1.92	1.60	1.48	2.10	2.12	.....
22	.....	2.15	1.90	4.42	2.05	1.62	1.50	2.05	2.12	1.82
23	.....	1.95	2.10	4.20	2.10	1.75	1.55	2.00	2.22	.....
24	.....	1.78	2.25	3.92	2.05	1.78	1.60	2.02	.....	.....
25	.....	1.62	2.40	3.70	2.00	1.80	1.65	2.00	2.35	2.00
26	.....	1.65	2.15	3.72	2.02	1.72	1.70	1.95	2.38	.....
27	.....	1.58	1.98	3.65	2.08	1.75	1.62	1.92	2.55	.....
28	.....	1.50	2.20	3.48	2.07	1.75	1.62	1.90	2.22	1.92
29	.....	1.55	2.00	3.38	2.05	1.70	1.60	1.88	1.88	.....
30	.....	1.50	2.45	3.30	2.02	1.72	1.58	1.85	1.85	.....
31	.....	.....	2.90	.....	2.02	1.70	.....	1.88	.....	2.10

a ... June 12 was 12.25 feet.

... ately's 1907 and during December, 1907. Private ... ember, 1908, the river was frozen over except at the ...

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Rating table for Milk River at Malta, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	55	2.80	559	4.60	1,688	7.60	3,578
1.40	67	2.90	618	4.80	1,814	7.80	3,704
1.50	82	3.00	680	5.00	1,940	8.00	3,830
1.60	100	3.10	743	5.20	2,066	9.00	4,460
1.70	121	3.20	806	5.40	2,192	10.00	5,090
1.80	145	3.30	869	5.60	2,318	11.00	5,720
1.90	172	3.40	932	5.80	2,444	12.00	6,350
2.00	202	3.50	995	6.00	2,570	13.00	6,980
2.10	235	3.60	1,058	6.20	2,696	14.00	7,610
2.20	272	3.70	1,121	6.40	2,822	15.00	8,240
2.30	312	3.80	1,184	6.60	2,948	16.00	8,870
2.40	355	3.90	1,247	6.80	3,074	17.00	9,500
2.50	401	4.00	1,310	7.00	3,200	18.00	10,130
2.60	450	4.20	1,436	7.20	3,326	19.00	10,760
2.70	503	4.40	1,562	7.40	3,452	20.00	11,390

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 13 discharge measurements made during 1907, and is well defined.

FOR 1908.

[Indirect method for shifting channels used during 1908.]

Daily discharge, in second-feet, of Milk River at Malta, Mont., for 1908.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		98	401	889	165	140	114	200
2		93	450	834	126	150	104	218
3		90	503	751	112	140	119	232
4		90	569	626	80	120	114	240
5		87	740	531	112	127	124	264
6		84	995	477	123	127	126	278
7		82	1,400	420	113	120	151	310
8	445	79	1,660	248	123	120	151	315
9	530	74	2,520	295	113	127	172	312
10	662	67	4,000	280	113	125	196	314
11	762	65	4,980	289	110	116	200	309
12	672	55	5,720	244	113	104	214	309
13	612	55	6,410	212	110	94	214	260
14	525	53	5,960	196	110	94	214	309
15	480	49	4,670	196	110	95	206	309
16	405	44	3,190	152	104	94	214	309
17	365	42	2,360	152	95	94	229	299
18	260	39	2,740	142	92	90	229	296
19	232	36	2,990	142	90	94	222	299
20	206	34	2,610	140	85	104	240	262
21	273	74	2,120	142	110	110	260	276
22	256	172	1,590	262	104	104	240	276
23	229	225	1,440	276	120	114	222	273
24	173	292	1,250	282	140	124	226	243
25	140	356	1,130	140	142	127	222	204
26	142	222	1,120	130	126	140	214	202
27	116	140	1,040	110	120	98	204	171
28	110	110	960	104	120	95	200	171
29	110	292	875	104	120	124	170	146
30	126	292	820	140	120	116	140	146
31	.....	42	.....	140	120	.....	126	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of Milk River at Malta, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	11,200	1,990	6,430	383,000	A.
May	2,160	819	1,390	85,500	A.
June	5,830	680	1,600	95,200	A.
July	2,320	254	883	54,300	B.
August	401	61	113	6,950	D.
September	334	61	132	7,860	D.
October	218	116	133	8,180	D.
November	145	74	102	6,070	D.
The period				647,000	
1908.					
April[a]	762	100	354	21,100	C.
May	410	34	134	8,240	C.
June	6,410	401	2,220	132,000	B.
July	899	160	310	19,100	B.
August	165	80	115	7,070	B.
September	150	94	118	7,020	C.
October	266	104	194	11,900	C.
November	470	186	292	17,400	D.
The period				224,000	

[a] Discharge for April 1–7 estimated.

MILK RIVER AT HINSDALE, MONT.

This station, which is located at the highway bridge over Milk River, about 1 mile from Hinsdale, Mont., a point 46 miles from its junction with Missouri River, was established May 13, 1908, to obtain data for use in connection with irrigation projects in Milk River valley.

Three tributaries enter between Malta and Hinsdale: Beaver Creek from the south and Frenchman and Rock creeks from the north. These streams discharge large volumes of water during the rainy weather in the spring and summer, but they are low or even dry during the fall and winter months.

No diversions are made between Malta and Hinsdale. The United States Reclamation Service has appropriated the flow of the stream in connection with the Milk River project and will divert it at a point 9 miles east of Hinsdale to irrigate land in lower Milk River valley.

From late in November until the 1st of April the stream is frozen entirely across and to a considerable depth. It is impracticable to keep gage records here during this period.

Discharge measurements of Milk River at Hinsdale, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Dischar
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-*
May 14[a]	Stewart and Huch	99	156	1.98	
May 27[b]	A. F. Huch	85	278	[c]2.93	
June 9	do			4.91	1
June 25	do			4.49	1
July 8	do			.08	
Aug. 10[a]	do			.11	
Sept. 28[a]	do			.70	

[a] Made by wading. [b] Made from boat.

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Daily gage height, in feet, of Milk River at Hinsdale, Mont., for 1908.

[M. F. Chester, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.00	3.80	1.95	2.26	1.30	1.85	16	1.96	9.30	2.45	1.51	1.56	1.80	2.05
2	.....	1.99	3.60	2.00	1.96	1.30	1.85	17	1.90	7.50	2.45	1.71	1.56	1.80	2.10
3	.....	1.90	3.50	2.00	1.96	1.30	1.85	18	1.90	6.50	2.35	1.96	1.56	1.80	2.10
4	.....	2.00	3.40	2.00	1.91	1.35	1.80	19	1.85	5.70	2.30	2.01	1.56	1.80	.....
5	.....	2.10	3.30	2.05	1.86	1.40	1.80	20	1.80	5.60	2.30	1.96	1.61	1.80	.....
6	.....	2.80	3.20	2.10	1.76	1.45	1.85	21	1.70	5.20	2.25	1.86	1.61	1.80	.....
7	.....	3.50	3.10	2.00	1.81	1.45	1.90	22	1.70	5.00	2.20	1.76	1.56	1.90	.....
8	.....	3.50	3.00	2.00	1.86	1.45	2.10	23	1.70	4.80	2.20	1.96	1.56	1.90	.....
9	.....	4.80	3.00	2.00	1.76	1.45	2.15	24	1.70	4.60	2.15	2.11	1.56	1.90	.....
10	.....	5.40	2.90	2.00	1.76	1.50	2.15	25	1.70	4.50	2.10	2.11	1.61	1.85	.....
11	.....	6.50	2.80	1.96	1.76	1.50	2.10	26	2.50	4.30	2.00	2.16	1.61	1.85	.....
12	.....	8.20	2.50	1.86	1.76	1.55	2.05	27	2.80	4.20	2.00	1.96	1.61	1.80	.....
13	2.00	9.50	2.50	1.76	1.66	1.60	2.00	28	2.60	4.10	2.00	1.91	1.66	1.80	.....
14	1.95	10.50	2.50	1.66	1.56	1.65	2.00	29	2.50	4.00	2.00	1.76	1.66	1.80	.....
15	1.95	10.80	2.50	1.51	1.56	1.80	2.00	30	2.30	3.90	1.95	1.76	1.66	1.80	.....
								31	2.20	.....	1.90	1.36	.....	1.80	.....

Rating table for Milk River at Hinsdale, Mont., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	29	2.50	295	3.70	830	4.80	1,525
1.40	33	2.60	330	3.80	885	4.90	1,585
1.50	40	2.70	370	3.90	940	5.00	1,665
1.60	50	2.80	410	4.00	1,000	5.20	1,805
1.70	65	2.90	450	4.10	1,060	5.40	1,945
1.80	85	3.00	490	4.20	1,120	5.60	2,095
1.90	110	3.10	535	4.30	1,185	5.80	2,245
2.00	135	3.20	580	4.40	1,250	6.00	2,395
2.10	165	3.30	625	4.50	1,315	6.20	2,545
2.20	195	3.40	675	4.60	1,385	6.40	2,695
2.30	225	3.50	725	4.70	1,455	6.60	2,850
2.40	260	3.60	775				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on twenty-one discharge measurements made during 1908–9 and is well defined between gage heights 1.6 feet and 5.0 feet. Above gage height 5.0 feet it is fairly well defined. Above gage height 6.5 feet the rating curve is a tangent, the difference being 80 per tenth.

Monthly discharge of Milk River at Hinsdale, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 15-31	410	65	157	5,920	A.
June	6,210	110	1,960	117,000	A.
July	885	110	348	21,400	A.
August	183	31	114	7,010	A.
September	213	46	71.9	4,280	B.
October	110	29	66.9	4,110	B.
November 1-18	180	85	133	4,750	A.
The period				164,000	

WEST FORK OF MILK RIVER AT C[illegible].

West Fork of Mi[illegible]s in the [illegible] of the Province of Albert[illegible]va south[illegible] boundary near Chinook[illegible]

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The gaging station, which is located about 1 mile east of Chinook, was established March 6, 1906, to obtain data for use in connection with irrigation projects in Milk River Valley. West Fork ditch diverts water from West Fork about 4 miles north of Chinook to irrigate land in Milk River Valley. The first diversion was made in 1898 to serve about 75 acres, but later the ditch was extended to irrigate, it is claimed, several hundred acres.

The original gage was an inclined staff located 170 feet above the bridge. On July 1, 1907, the station was moved to the Rainholt ranch, 2 miles upstream, where it remained until April 16, 1908, when it was moved back to the bridge at the same datum as the old gage. On July 9, 1908, it was again moved to the Rainholt ranch, where it still remains. These changes were made because it was impossible to make measurements from the bridge and also because the water from the Fort Belknap canal was at times emptied into the stream above the gage at the bridge. There was no flow after June 26, 1908, and very little at any time during the year.

Results at this station are only fair. The gage heights during high-water periods were affected by back water from Milk River. The stream often goes dry in the autumn and winter months.

Discharge measurements of West Fork of Milk River at Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	Follansbee and Pierson	42	208	6.64	214
April 11	J. B. Pierson	66	587	12.73	734
April 15	do	80	866	16.45	1,410
April 20	do	71	695	14.50	1,180
April 24	Follansbee and Pierson				[a] 335
May 3	J. B. Pierson	43	270	7.36	306
May 13	do	43	274	7.38	290
May 27	do	33	164	4.71	115
June 15	do	32	113	3.20	18.2
June 24	do	45	282	7.55	300
June 25	do	33	154	4.40	94
June 26	Follansbee and Pierson	33	28.8	.92	33.1
July 6	J. B. Pierson	20	11.6	.51	12.2
July 16	do	16	7.2	.36	6.8
July 20	do	16	6.1	.32	5.3
July 29	do	12	3.9	.19	1.6
August 19	do	2	.2	.16	.1
August 26	do	.5		.06	.0
1908.					
May 5	A. F. Huch	12	7.36	[b] .42	4.1
May 26	do		.35	3.06	[c] .2
June 7	do			3.3	[c] .2

[a] Overflow. The gage at the regular station read 16.5 feet.
[b] Old gage read 3.28 feet.
[c] Discharge estimated.

NOTE.—From June 26, 1907, to May 5, 1908, the gage heights refer to a new gage placed 2 miles above the old one. The measurements were made by wading at various sections near the gage.

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Daily gage height, in feet, of West Fork of Milk River at Chinook, Mont., for 1907 and 1908.

[Carrie M. Prosser and Agnes Prosser, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1907.							1907.						
1		3.25	5.55	4.00	0.95	0.16	16		16.70	6.40	3.15	0.38	
2		4.25	5.60	3.90	.85	.15	17		16.45	6.15	3.10	.35	
3		4.60	6.70	3.70	.69	.14	18		16.45	5.68	3.10	.35	
4		4.25	6.55	3.60	.68	.10	19		15.05	5.85	3.15	.35	
5		5.05	5.95	3.60	.58	.10	20		14.35	6.45	3.25	.35	
6		7.15	5.75	3.60	.52	.10	21		14.90	6.15	3.40	.30	
7		6.90	5.40	3.60	.48	.09	22		16.70	5.60	3.45	.29	
8		5.50	5.95	3.55	.42	.08	23	3.70	16.90	5.00	3.05	.22	
9		10.10	5.90	3.50	.45	.08	24	3.75	16.30	5.45	6.00	.20	
10		11.10	5.70	3.35	.40	.06	25	3.65	13.05	5.55	4.50	.20	
11		12.80	6.85	3.45	.40		26	3.50	10.65	5.00	4.50	.20	
12		11.65	8.35	3.35	.39		27	3.35	8.80	4.75	3.70	.20	
13		12.65	7.65	3.25	.39		28	3.25	7.25	4.50	3.40	.20	
14		15.40	6.30	3.20	.40		29	3.20	7.05	4.35	3.20	.20	
15		16.55	6.45	3.20	.40		30	3.20	6.25	4.25	2.85	.18	
							31	3.20		4.10		.18	

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1908.				1908.				1908.			
1		3.75	3.6	11		3.1	7.05	21	4.4	3.3	3.6
2		3.35	3.55	12		3.1	4.9	22	4.15	3.05	3.6
3		3.3	3.7	13		3.1	3.8	23	3.85	3.35	3.65
4		3.3	3.8	14		3.1	3.55	24	3.4	3.3	3.7
5		3.3	3.85	15		3.1	3.25	25	3.65	3.25	3.8
6		3.55	3.7	16	3.5	3.4	3.1	26	3.6	3.25	3.25
7		3.3	3.3	17	4.3	3.35	3.2	27	3.7	3.05	2.9
8		3.15	3.1	18	4.85	3.3	3.55	28	3.6	2.9	2.9
9		3.1	3.85	19	4.55	3.5	3.6	29	3.6	3.0	2.95
10		3.05	5.25	20	4.45	3.5	3.6	30	3.6	3.0	3.0
								31		3.6	

NOTE.—Gage heights July 1–August 10, 1907, refer to new gage, and are not comparable with the old one. Gage heights for 1908 refer to old gage.
Gage heights June 9–13 (about), 1908, affected by backwater due to floods on Milk River.
Practically no flow January 1–March 22 and August 11–December 31, 1907.
There was no flow after June 26, 1908, and very little at any time during the year.

Daily discharge, in second-feet, of West Fork of Milk River at Chinook, Mont., for 1907.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1		19	175	68	35	1	16		1,850	220	20	7	
2		64	178	62	29	1	17		1,720	204	17	7	
3		62	251	51	21	1	18		1,720	174	17	7	
4		64	240	45	20	.3	19		1,220	184	20	7	
5		106	196	45	18	.3	20		1,160	224	26	7	
6		520	196	45	13	.3	21		1,250	304	24	6	
7		280	140	45	11	.3	22		1,420	166	27	6	
8		135	196	43	9	.3	23	25	2,050	166	44	2	
9		462	185	39	10	.3	24	25	1,700	140	226	2	
10		800	174	31	8	0	25	25	960	165	98	2	
11		760	250	27	8		26	29	620	124	98	2	
12		625	250	31	8		27	25	430	119	56	2	
13		750	214	26	8		28	19	305	90	32	2	
14		1,200	212	25	8		29	17	274	69	20	2	
15		1,200	225	23	8		30	17	220	64	11	2	
							31	17		74		2	

Note.—These discharges were obtained by the ordinary method of using rating tables.

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Monthly discharge of West Fork of Milk River at Chinook, Mont., for 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March 23–31	29	17	21.9	391	C.
April	2,050	19	810	48,200	B.
May	370	74	187	11,500	A.
June	236	15	46.1	2,740	B.
July	35	2	8.8	541	B.
August	1	0	.19	12	D.

NORTH FORK OF MILK RIVER NEAR CHINOOK, MONT.

This station, which is located about 4½ miles north of Chinook, Mont., and about 7 miles above the junction of North Fork with Milk River, was established April 22, 1905, to obtain data for use in connection with irrigation projects in Milk River valley.

No storage is used on this stream. Three canals which divert an aggregate of about 20 second-feet take out above the station. Several small pumping plants which supply water for irrigating the bottom land along the river valley also operate above the station. Below the station the Matheson and Cook canals divert water for irrigating land in Milk River valley near the mouth of North Fork. The aggregate appropriation of these canals is 78 second-feet.

The results at this station may be considered reliable as a fair rating curve has been obtained. Ice during the winter months makes gage readings impracticable. The datum of the gage has remained the same since the station was established in 1905.

The greater part of the run-off occurs during floods caused by heavy rains in the spring and early summer. The stream often goes dry in the fall.

Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 8	Robert Follansbee	63	282	4.54	802
April 11	J. B. Pierson	79	588	8.17	2,180
April 12	do	73	500	6.55	1,480
April 15	do	78	561	8.35	a 3,090
April 20	do	66	329	4.88	986
April 24	do	71	463	6.38	1,490
April 27	do	65	358	4.90	997
May 3	do	62	271	4.14	697
May 13	do	62	182	3.37	463
May 27	do	57	123	2.24	233
June 13	do	56	61	1.29	94
June 21 b	do	56	62	L 34	83
June 25	do	56	76	L 63	133
July 6 b	do	62	46	1.10	54
July 16	do	56	67	1.41	87
July 29 b	do	32	18.8	.78	23.5
August 17 b	do			.49	5.2
August 19 b	Follans				4.9
August 26 b	J. B. Pier				2.2
October 19 b	Follans				12.9

a Measured.

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Discharge measurements of North Fork of Milk River near Chinook, Mont., in 1907 and 1908—Continued.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		Feet.	Sq. ft.	Feet.	Sec.-ft.
April 6[a]	Stewart and Huch	56	80	1.57	90.4
April 22	A. F. Huch	56	62.8	1.35	69.2
May 5	do	56	45.3	.90	46.2
May 26[b]	do	24	11.1	.81	9.8
June 4[b]	do	21	12.8	.80	13.8
July 7	do			.15	[c] 17

[a] Measurement made through the ice. Gage height top of ice 1.6 feet. Gage height under surface of ice 1.2 feet.

[b] Made by wading.

[c] Estimated.

Daily gage height, in feet, of North Fork of Milk River near Chinook, Mont., for 1907 and 1908.

[Mrs. R. B. Snedecker, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		1.65	2.85	1.68	1.44	0.69	0.45	0.66	0.70	0.77
2		1.65	4.12	1.62	1.42	.66	.39	.65	.70	.70
3		1.65	4.40	1.60	1.36	.63	.38	.65	.70	.70
4		1.68	3.48	1.55	1.28	.61	.35	.63	.70	.80
5		1.70	2.80	1.52	1.20	.58	.31	.62	.70	.80
6		4.05	2.88	1.48	1.16	.57	.29	.61	.70	.81
7		5.15	2.85	1.45	1.09	.56	.29	.58	.70	.81
8		[c] 4.50	2.68	1.42	.96	.53	.28	.57	.70	.81
9		6.45	2.82	1.42	1.17	.51	.27	.57	.70	
10		8.42	2.92	1.40	1.06	.49	.26	.57	.78	
11		7.75	2.72	1.38	1.00	.48	.24	.59	.80	
12		6.38	3.10	1.38	.96	.46	.27	.59	.80	
13		6.22	3.30	1.55	2.70	.43	.30	.61	.82	
14		7.20	2.72	2.25	2.53	.42	.40	.62	.82	
15		8.25	2.68	1.75	2.38	.42	.43	.62	.82	
16		7.28	2.35	2.52	1.44	.43	.44	.62	.80	
17		5.30	2.25	2.15	1.40	.44	.45	.62	.80	
18		5.10	2.22	2.02	1.29	.45	.47	.64	.80	
19		5.25	2.15	1.82	1.07	.44	.49	.63	.80	
20		4.95	2.20	1.60	1.07	.42	.50	.64	.82	
21	2.12	7.05	2.15	1.38	1.05	.39	.60	.64	.81	
22	1.50	6.45	2.16	1.66	.99	.36	.72	.67	.80	
23	2.25	7.72	2.15	1.56	.96	.34	.73	.68	.80	
24	1.88	6.45	2.20	2.25	.92	.32	.72	.68	.78	
25	1.72	5.50	2.02	1.65	.86	.30	.76	.69	.77	

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Daily gage height, in feet, of North Fork of Milk River near Chinook, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
16	1.65	1.75	0.71	0.69	0.06	.....	.....	.....	.....	0.84
17	1.65	2.12	.63	.62	.....	.....	.....	.....	.....	.84
18	1.60	2.08	.63	.62	.....	.....	.....	.....	.....	.84
19	1.60	1.85	.62	.58	.....	.....	.....	.....	.....	.84
20	1.58	1.68	.61	.52	.....	.....	.....	.....	0.69	.84
21	1.58	1.48	.60	.44	.....	.....	.....	.....	.80	.84
22	1.60	1.34	.60	.40	.....	.....	.....	.....	.84	.84
23	1.64	1.32	.60	.39	.....	.....	.....	.....	.70	.84
24	1.68	1.31	.59	.38	.....	.....	.....	.....	.50	.84
25	1.62	1.26	.58	.36	.....	.....	.....	.....	.56	.84
26	1.50	1.21	.52	.34	.....	.....	.....	.....	.70	.84
27	1.50	1.20	.51	.31	.....	.....	.....	.....	1.15	.84
28	1.50	1.16	.49	.28	.....	.....	.....	.....	1.36	.84
29	1.52	1.15	.48	.26	.....	.....	.....	.....	.46	.84
30	1.59	1.15	.45	.25	.....	.....	.....	.....	1.50	.84
31	1.60	.....	.43	.....	.....	.....	.....	.....	.....	.84

NOTE.—Ice conditions January 1 to April 6, 1907; during a part of this period the river was frozen to the bottom at the gage, but there was considerable flow at the far side of the channel. Slight ice conditions in November, 1907. River frozen December 9, 1907, to April 10, 1908, and December 1 to 31, 1908. From July 8 to November 20, 1908, there was practically no flow, water standing in pools.

Rating table for North Fork of Milk River near Chinook, Mont., for 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	0	1.60	116	3.00	400	4.80	912
.30	2	1.70	133	3.10	424	5.00	980
.40	4	1.80	151	3.20	448	5.20	1,052
.50	7	1.90	170	3.30	472	5.40	1,124
.60	11	2.00	190	3.40	496	5.60	1,198
.70	17	2.10	210	3.50	522	5.80	1,274
.80	24	2.20	230	3.60	548	6.00	1,350
.90	32	2.30	250	3.70	574	6.20	1,430
1.00	41	2.40	270	3.80	602	6.40	1,510
1.10	51	2.50	291	3.90	630	6.60	1,590
1.20	62	2.60	312	4.00	658	6.80	1,670
1.30	74	2.70	333	4.20	718	7.00	1,750
1.40	87	2.80	355	4.40	780	8.00	2,170
1.50	101	2.90	377	4.60	844	9.00	2,606

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on nineteen discharge measurements made during 1907, and is well defined below gage height 4.5 feet. Above gage height 4.5 feet the rating is fairly well defined.

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Daily discharge, in second-feet, of North Fork of Milk River near Chinook, Mont., for 1908.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	74	9	1	16	118	22	22	.....
2	.....	106	10	1	17	190	17	17	.....
3	.....	95	12	1	18	182	17	17	.....
4	.....	56	14	1	19	137	16	15	.....
5	.....	48	19	1	20	106	15	12	.....
6	.....	46	18	1	21	77	15	9	.....
7	.....	42	19	1	22	62	15	7	.....
8	.....	39	19	1	23	64	15	6	.....
9	.....	35	18	.....	24	63	14	6	.....
10	.....	30	16	.....	25	58	14	5	.....
11	38	29	14	.....	26	57	10	4	.....
12	33	29	12	.....	27	56	10	3	.....
13	38	29	13	.....	28	52	10	2	.....
14	68	28	18	.....	29	56	9	2	.....
15	111	25	22	.....	30	56	9	1	.....
					31	.....	9	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Fork of Milk River near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 21–31	240	101	146	3,190	A.
April	2,360	124	1,150	68,400	A.
May	780	130	332	20,400	A.
June	295	84	128	7,620	A.
July	333	20	74.8	4,600	B.
August	16	1	6.2	381	C.
September	19	1	7.7	456	C.
October	17	10	13.7	842	B.
November	26	17	20.1	1,200	C.
December 1–8	25	22	23.9	379	C.
The period	.....	.....	.....	107,000	
1908.					
March	.....	.....	a 20.0	1,840	D.
April	190	30	64.1	3,810	C.
May	105	9	29.9	1,840	A.
June	19	1	12.0	714	C.
November, 29–30	.....	.....	a 15.0	328	D.
December	.....	.....	a 10.0	615	D.

a Estimated.

NOTE.—Practically no flow in July, August, September, and October, 1908.

BEAVER CREEK NEAR ASHFIELD, MONT.

Beaver Creek rises in the little Rocky Mountains, flows northeastward, and enters Milk River near Hinsdale, Mont.

The gaging station, which was established December 31, 1903, to obtain data for use in connection with irrigation projects in Milk River valley, is located at Craig's ranch, about 18 miles from Malta and 3 miles south of Ashfield, Mont., the nearest post-office. It was discontinued from August 30, 1906, to May 2, 1908.

The only diversion is that for the irrigation of land bordering the stre[illegible]. The water is diverted by small ditches leading from the [illegible]nd by small pumping plants near the banks.

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The entire run-off from this area does not pass the station. At medium and high stages a second channel, known as Beaver Creek overflow, leaves the stream above the station, follows a depression to the west of the main channel, and reenters at a point some distance below the gage. Records are kept of the flow of this channel.

The gage was first established at bridge No. 455 of the Great Northern Railway, one-half mile west of Ashfield, Mont. It was moved to its present location 2½ miles upstream December 31, 1903. The stream carries but little water except at the times of the spring floods or heavy rains. During the summer months the channel is obstructed by a dense growth of weeds and willows, which have to be cleared out occasionally, thus making it a difficult matter to procure a permanent rating. The results therefore are only fair. The gage heights for 1908 are too unreliable to publish.

Discharge measurements of Beaver Creek near Ashfield, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 2	A. F. Huch	18	6.8	0.35	1.8
May 12	Stewart and Huch		.6	.14	a.4
June 8	A. F. Huch			.00	a.01

a Float measurement.

BEAVER CREEK OVERFLOW NEAR BOWDOIN, MONT.

This station which was established June 29, 1903, discontinued August 30, 1906, and reestablished May 2, 1908, is located at John Turmell's ranch, 14 miles from Malta, Mont.

The flow of this channel must be added to that of the Beaver Creek station to get the total flow from the drainage area. The channel was practically without flow during the season of 1908 as the water was standing in pools.

Daily gage height, in feet, of Beaver Creek overflow near Bowdoin, Mont., for 1908.

[John Turnell, observer.]

Day.	May.	June.	July.	Aug.	Day.	May.	June.	July.	Aug.
1	.....	2.4	1.6	1.2	16	2.9	2.2	1.4	1.0
2	.....	2.4	1.6	1.2	17	2.8	2.1	1.3	1.0
3	3.25	2.4	1.6	1.1	18	2.8	2.1	1.3	1.0
4	3.25	2.4	1.6	1.1	19	2.8	2.1	1.3	1.0
5	3.25	2.4	1.5	1.1	20	2.7	2.1	1.3	1.0
6	3.15	2.4	1.5	1.1	21	2.7	2.0	1.3	1.0
7	3.15	2.3	1.5	1.1	22	2.6	2.0	1.3	1.0
8	3.15	2.3	1.5	1.1	23	2.6	1.9	1.3	1.0
9	3.05	2.3	1.5	1.1	24	2.6	1.9	1.2	.9
10	3.05					2.6	1.8	1.2	.9
11	2.95					2.5	1.8	1.2	.9
12	2.95						1.7	1.2	.9
13	3.0						1.7	1.2	.8
14	3.0						1.7	1.2	.8
15								1.2	.8
								1.2	.8

NOTE.—Practically

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This station, which was established March 28, 1906, to obtain data for use in connection with the Milk River irrigation project, was discontinued September 30, 1907. It was located just below the diversion dam for Rock Creek canal and 7 miles north of Hinsdale.

Willow Creek, the only important tributary of Rock Creek, drains the country to the east and enters a few miles above the station. The most important diversion is the Rock Creek canal, which takes out water a few hundred feet above the station.

Measurements were made from a cable, but in low water they were made by wading. During the last part of the year the creek goes dry and the water stands in pools. Records obtained were very good.

Discharge measurements of Rock Creek near Hinsdale, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18 [a]	J. B. Pierson	77	531	7.26	1,310
April 23 [a]	do	111	1,070	13.07	3,670
April 25 [b]	do	75	519	6.93	1,390
May 21 [c]	do	60	375	4.83	664
May 28 [d]	do	53	283	3.35	219
June 17 [e]	do	53	266	3.10	217
July 9 [e]	do	53	266	1.84	30.6
July 31 [e]	do			1.36	1.0
August 21	do				.0
October 21 [e]	Robert Follansbee			1.49	1.5

[a] Canal dry.
[b] Large flow in canal; not measured.
[c] Canal flow = 326 second-feet.
[d] Canal flow = 284 second-feet.
[e] Estimated.

NOTE.—Just after the measurement of April 23, 1907, the head gates of the canal were washed out and during the remainder of the high-water period water flowed through the canal, except for short intervals when it was stopped temporarily.

Daily gage height, in feet, of Rock Creek near Hinsdale, Mont., for 1907.

[F. E. Halbert, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	2.8	6.4	2.8	2.2	1.3	3.1	16	7.25	4.8	4.6	1.7	1.3	1.3
2	4.4	6.7	2.4	2.2	1.3	2.9	17	5.7	4.7	3.9	1.5	1.3	1.3
3	6.1	6.5	2.3	2.2	1.3	2.9	18	5.9	4.8	3.2	1.5	1.3	1.3
4	6.3	6.2	2.2	2.2	1.3	2.8	19	5.9	4.8	2.7	1.5	1.4	1.3
5	5.9	6.0	2.8	2.2	1.3	2.2	20	7.5	4.8	2.5	1.4	1.4	1.3
6	6.2	5.9	2.6	2.2	1.3	1.5	21	9.7	4.8	2.4	1.4	1.4	1.3
7	8.6	5.9	2.5	2.2	1.3	1.4	22	11.95	5.0	2.3	1.4	1.4	1.3
8	9.7	5.8	2.4	2.2	1.3	1.4	23	11.2	5.4	2.3	1.4	1.4	1.3
9	9.9	5.8	2.6	2.1	1.3	1.4	24	10.4	6.7	2.2	1.4	1.4	1.3
10	10.4	5.6	2.6	2.1	1.3	1.4	25	8.7	7.7	2.3	1.4	1.4	1.3
11	11.6	5.5	2.4	2.0	1.3	1.4	26	7.2	6.2	2.2	1.4	1.4	1.3
12	11.6	5.5	2.4	1.9	1.3	1.4	27	7.2	5.7	2.2	1.4	1.4	1.3
13	12.6	7.3	2.3	1.9	1.3	1.4	28	6.9	5.3	2.2	1.4	1.4	1.3
14	13.6	5.6	2.3	1.8	1.3	1.4	29	6.7	4.9	2.2	1.3	1.4	1.2
15	9.7	5.6	6.6	1.8	1.3	1.4	30	6.5	4.6	2.2	1.3	1.4	1.2
							31		2.7		1.3	1.4	

[illegible] 28, 1907. [illegible] January 1 to March 31, 1907 (approxi-

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Rating table for Rock Creek near Hinsdale, Mont., for April 1, 1906, to September 30, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	0	3.00	182	4.80	630	8.20	1,695
1.30	.5	3.10	201	4.90	659	8.40	1,763
1.40	2	3.20	221	5.00	688	8.60	1,831
1.50	7	3.30	242	5.20	746	8.80	1,901
1.60	13	3.40	264	5.40	805	9.00	1,971
1.70	20	3.50	287	5.60	865	10.00	2,343
1.80	27	3.60	311	5.80	925	11.00	2,750
1.90	35	3.70	335	6.00	985	12.00	3,180
2.00	44	3.80	360	6.20	1,047	13.00	3,620
2.10	54	3.90	385	6.40	1,109	14.00	4,080
2.20	65	4.00	411	6.60	1,171	15.00	4,550
2.30	77	4.10	437	6.80	1,235	16.00	5,030
2.40	89	4.20	463	7.00	1,299	17.00	5,520
2.50	102	4.30	490	7.20	1,363	18.00	6,020
2.60	116	4.40	517	7.40	1,428	18.40	6,220
2.70	131	4.50	545	7.60	1,494		
2.80	147	4.60	573	7.80	1,560		
2.90	164	4.70	601	8.00	1,627		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on ten discharge measurements made during 1907 and one in 1906, and is fairly well defined between gage heights 1.2 feet and 14.0 feet.

Monthly discharge of Rock Creek near Hinsdale, Mont., for 1906 and 1907.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1906.					
April	16	0	0.83	49	D.
May	3,080	0	225	13,800	C.
June, 27 days	6,220	2	807	43,200	B.
July 1–12	77	0	38.6	916	D.
The period				58,000	
1907.					
April	5,520	102	1,900	113,000	B.
May	1,530	201	832	51,200	A.
June	630	65	150	8,930	B.
July	65	.5	27.6	1,700	D.
August	89	.5	3.49	242	D.
September	201	.0	25.7	1,530	D.
The period				177,000	

NOTE.—No record of discharge for missing days in June, 1906, because of high water. Maximum for month as given is only approximate.
Values of accuracy as given apply only to the water flowing in the creek and are exclusive of the canal.

PORCUPINE CREEK AT NASHUA, MONT.

Porcupine Creek rises in the northern part of Valley County, Mont., flows southward, forming the west boundary of the Fort Peck Indian Reservation, and enters Milk River at Nashua, a point about 5 miles from the junction of Milk River with the Missouri.

The drainage area comprises a strip of rolling prairie about 40 miles long and [illegible] but a short distance back from the narrow valley formed by the stream. Forestation is lacking, except a growth of willow [illegible] cottonwoods along the banks of the stream.

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The greater part of the run-off comes from the melting snow in the early spring and from heavy rains during the summer. In the late summer and winter the stream is dry. The annual rainfall is about 13 inches. The water of this stream is neither diverted nor stored.

The only gaging station is at the road crossing at Nashua. It was established July 11, 1908, to obtain data for an irrigation project under construction by the United States Reclamation Service for the Fort Peck Indians.

The following discharge measurement was made at this station on July 12, 1908:

Gage height, 1.70 feet; discharge estimated as 0.1 second-foot.

Daily gage height, in feet, of Porcupine Creek at Nashua, Mont., for 1908.

[Wm. H. Todd, observer.]

Day.	July.	Aug.	Day.	July.	Aug.	Day.	July.	Aug.
1		0.6	11	1.7		21	1.1	
2		.5	12	1.6		22	1.1	
3		.5	13	1.6		23	1.0	
4		.5	14	1.3		24	.7	
5		.5	15	1.3		25	.9	
6		.4	16	1.9		26	.8	
7		.4	17	1.4		27	.7	
8		.3	18	1.3		28	.7	
9			19	1.2		29	.7	
10			20	1.2		30	.7	
						31	.6	

NOTE.—Except for July 16 there was practically no running water after July 11.

PRIVATE CANALS IN MILK RIVER VALLEY.

DESCRIPTION.

Since 1905 a number of stations have been maintained on private canals in Milk River valley for the purpose of ascertaining the extent of private water rights. With the exception of Peck Creek canal, which is near Hinsdale in Valley County, these canals are located in Chouteau County and are used to irrigate lands in the vicinity of Harlem and Chinook.

The canals are all built on small [illegible] and have been enlarged. In many of them silt has [illegible] and some contain a growth of weeds [illegible] is uniformly sluggish. In order to [illegible] checks are erected in the main canals [illegible] back-water effects for long distances [illegible] a great variety of conditions, and [illegible] differ widely at the same gage height [illegible] exact relation between [illegible] several rating [illegible] measurements [illegible]

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The following gaging stations have been here maintained:

Paradise Valley canal near Chinook, Mont., 1903–1908.
Cook canal near Chinook, Mont., 1905–1908.
Matheson canal near Chinook Mont., 1905–1908.
Harlem canal near Zurick, Mont., 1903–1908.
Agency ditch near Harlem, Mont., 1905–1908.
Fort Belknap canal near Chinook, Mont., 1903–1908.
Winter Anderson canal near Chinook, Mont., 1906–1908.
Rock Creek canal near Hinsdale, Mont., 1905–1907.

PARADISE VALLEY CANAL NEAR CHINOOK, MONT.

This station, which was established in June, 1903, is located near the head-gate at Rudolph Friede's ranch and is reached by driving about 7 miles along the south river road from Chinook.

Discharge measurements of Paradise Valley canal near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	J. B. Pierson	17	16.0	1.55	7.7
June 3	....do	.....	.....	.68	.0
June 19	....do	.....	.....	1.16	.0
July 8	....do	9	3.6	1.49	2.6
July 17	....do	8	2.7	1.26	1.3
July 30	....do	9	2.4	1.09	1.4
August 17	....do	14	13.1	1.60	7.0
August 24	....do	12	11.4	1.58	6.1
September 10	....do	6	3.5	1.04	1.0
September 27	Robert Follansbee	12	7.5	1.31	2.1
1908.					
April 7	Stewart and Huch	18	12.6	1.41	5.3
April 27	A. F. Huch	27	29.9	1.89	22.6
May 6	....do	26	21.8	1.50	10.8
May 15	Stewart and Huch	19	15.8	1.28	6.2
May 25	A. F. Huch	22	22.1	1.51	7.0
June 2	....do	18	4.2	1.41	[a] 4.2
June 12 [b]	....do	7	1.3	1.00	1.0
June 24 [b]	....do	7	3.8	1.20	1.7
July 6 [b]	....do	9	8.5	1.60	5.3
July 17 [b]	....do	11.5	9.8	1.80	7.1
August 6	....do	11	10.9	1.90	6.7

[a] Measurement affected by growth in canal.

[b] Made by wading.

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Daily gage height, in feet, of Paradise Valley canal near Chinook, Mont., for 1907 and 1908.

[Rudolph Friede, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1907.							1906.						
1	.....	0.71	.....	1.45	1.36	1.40	1	.....	1.61	1.61	1.83	1.80	1.19
2	.....	.66	1.78	1.41	1.47	1.31	2	.....	1.58	1.44	1.70	1.66	1.21
3	.....	.68	1.94	1.55	1.51	1.29	3	.....	1.68	1.45	1.71	1.52	1.21
4	.....	.60	1.81	1.50	1.37	1.38	4	.....	1.44	1.29	1.78	1.33	1.18
5	.....	.55	1.52	1.44	.98	1.30	5	1.50	1.51	1.38	1.73	1.74	1.12
6	.....	.54	1.48	1.35	.95	1.33	6	1.50	1.55	1.20	1.60	1.92	1.08
7	.....	.79	1.42	1.32	.90	1.30	7	1.40	1.50	1.19	2.49	1.86	1.02
8	.....	1.16	1.49	1.15	1.08	1.32	8	1.60	1.49	1.11	1.81	1.83	.....
9	1.00	1.26	1.43	1.40	1.02	1.31	9	1.05	1.55	1.10	1.76	1.71	.....
10	1.10	1.36	1.38	1.74	1.05	1.33	10	.98	1.61	1.10	1.72	1.63	.....
11	1.32	1.65	1.40	1.81	1.03	1.32	11	1.18	1.61	1.10	1.81	1.93	.....
12	1.38	1.61	1.33	1.76	1.04	1.30	12	1.18	1.59	1.04	1.81	2.00	.....
13	1.47	1.63	1.28	1.79	1.07	1.30	13	1.00	1.57	.98	1.82	1.89	.....
14	1.54	2.04	1.62	1.78	1.08	1.33	14	1.48	1.64	.97	1.83	1.97	.....
15	1.45	1.56	1.31	1.72	1.08	1.29	15	2.05	1.26	.97	1.82	1.88	.....
16	1.31	1.24	1.22	1.59	1.10	1.29	16	2.00	1.27	.94	1.82	1.87	.....
17	1.22	1.22	1.21	1.59	1.09	1.29	17	1.82	1.30	.93	1.82	1.86	.....
18	1.23	1.12	1.17	1.57	1.08	1.28	18	1.90	1.27	.93	1.75	1.90	.....
19	1.11	1.16	1.08	1.52	1.28	1.31	19	1.84	1.31	.90	1.85	1.90	.....
20	1.07	.93	1.03	1.48	1.16	1.29	20	1.82	1.30	1.61	1.88	1.89	.....
21	1.08	.92	.98	1.47	1.11	1.28	21	1.80	1.30	1.45	1.90	1.86	.....
22	1.31	1.62	1.01	1.49	1.41	1.18	22	1.75	1.50	1.40	1.88	1.81	.....
23	1.37	2.10	.88	1.42	1.33	1.27	23	1.84	1.41	1.27	1.89	1.87	.....
24	1.31	1.29	.80	1.59	1.16	1.26	24	1.82	1.53	1.20	1.82	1.70	.....
25	1.50	1.10	.88	1.63	1.70	1.29	25	1.85	1.51	1.13	1.81	1.44	.....
26	1.52	.98	.61	1.50	1.75	1.31	26	1.82	1.47	1.00	1.89	1.33	.....
27	1.24	.78	.50	1.36	1.28	1.33	27	1.85	1.49	1.19	1.78	1.28	.....
28	1.10	.74	1.28	1.25	1.29	1.32	28	1.88	1.51	1.00	1.73	1.28	.....
29	.92	.73	1.23	1.12	1.37	1.31	29	1.88	1.57	.98	1.89	1.30	.....
30	.81	.68	1.10	1.11	1.19	1.30	30	1.63	1.50	1.99	1.78	1.21	.....
31	.75	.....	1.30	1.39	.....	1.27	31	.....	1.49	.....	1.64	1 19	.....

Monthly discharge of Paradise Valley canal near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
May 9–31	7.7	0.3	4.00	182
June	12.2	.0	1.54	92
July	9.1	.0	1.89	116
August	9.7	1.5	5.38	331
September	7.2	.4	2.18	130
October	2.9	1.2	2.07	127
1908.				
April 5–30	22	1	13.9	717
May	16	5	8.97	552
June	14	.0	2.20	131
July	22	5	7.71	474
August	8	.0	5.03	309

NOTE.—The estimates are only approximate, owing to great and irregular fluctuation of daily stages.

COOK CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a small wooden highway bridge on the road running parallel to the Great Northern Railway, about 3 miles east of Chinook.

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Discharge measurements of Cook canal near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 24	J. B. Pierson	.....	.....	2.40	0.0
May 10	do	.....	.....	2.63	1.0
May 25	do	.....	.....	.....	.0
June 4	do	.....	.....	.....	.0
July 6	do	9	4.5	2.38	3.3
July 29	do	13	12.6	3.05	8.2
August 19	do	.....	.....	2.00	.0
1908.					
April 6	Stewart and Huch	.....	.....	2.20	.....
April 25	A. F. Huch	13.5	28.1	[a] 2.06	12.4
May 4	do	14	37.7	3.51	31.5
May 11	do	15	35.3	3.37	21.2
May 15	Stewart and Huch	14	34.6	3.28	18.5
May 26	A. F. Huch	15	10.8	2.19	[b] 3.7
June 3	do	14	11.6	2.29	[b] 5.0
June 13	do	13	8.55	2.04	[b] 1.5
June 23	do	14	11.6	2.38	[b] 4.1
July 7	do	7.5	4.56	[a] 1.24	[b] 2.5
July 16	do	7	3.23	2.00	[b] .9
Aug. 4	do	8.5	5.40	[a] 1.30	[b] 2.9

[a] Gage probably read 1 foot too low. [b] Made by wading.

Daily gage height, in feet, of Cook canal near Chinook, Mont., for 1907 and 1908.

[Herbert Reynolds, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1907.						1907.					
1	.....	2.5	3.3	3.2	3.1	16	1.9	2.1	3.3	2.7	2.5
2	.....	2.5	3.3	3.3	3.1	17	2.5	.....	3.3	2.7	2.6
3	.....	2.5	3.2	3.5	3.1	18	3.3	.....	3.3	2.6	2.6
4	.....	2.5	3.5	2.9	3.1	19	3.1	.....	3.4	2.5	2.6
5	.....	2.4	3.5	2.8	3.0	20	3.1	3.1	3.4	2.5	1.9
6	.....	2.4	3.4	2.1	2.9	21	3.6	3.0	3.5	2.7	.....
7	.....	2.4	3.3	2.4	2.8	22	2.8	3.0	3.5	2.7	.....
8	.....	2.4	3.3	2.9	2.7	23	2.4	3.1	2.8	2.9	.....
9	.....	2.4	3.3	2.9	2.6	24	2.4	3.0	3.2	2.9	.....
10	.....	2.6	3.3	2.9	2.6	25	2.5	3.3	3.6	2.9	.....
11	2.7	2.6	3.2	2.8	2.6	26	2.5	3.1	3.2	2.9	.....
12	2.7	2.6	3.2	2.8	2.6	27	2.5	2.8	2.1	2.9	.....
13	2.8	2.1	3.3	2.8	2.6	28	2.5	2.8	2.2	2.9	.....
14	2.2	2.8	3.4	2.8	2.5	29	2.6	3.1	3.3	3.0	.....
15	2.2	2.2	3.3	2.7	.....	30	2.4	3.1	3.4	3.0	.....
						31	.....	3.3	.....	3.0	.....

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1908.						1908.					
1	.....	3.6	2.5	2.8	2.0	16	3.7	3.3	2.0	1.8	3.1
2	.....	3.7	2.3	2.8	2.0	17	3.6	3.3	2.0	1.8	2.7
3	.....	3.5	2.4	2.9	2.0	18	3.8	3.4	2.0	1.8	2.6
4	.....	3.5	2.4	2.8	.....	19	3.4	3.2	2.1	1.9	2.6
5	.....	3.4	2.7	2.0	2.1	20	3.3	3.1	2.0	1.9	2.5
6	.....	3.6	2.7	2.4	2.2	21	3.2	3.9	2.4	2.0	2.5
7	.....	3.4	2.7	2.2	2.2	22	3.4	2.3	2.3	2.0	2.5
8	2.4	3.4	2.8	2.0	2.2	23	3.5	2.4	2.4	2.0	2.5
9	2.9	3.5	2.8	1.9	3.2	24	3.9	2.8	2.3	2.0	2.5
10	2.4	3.4	2.5	1.8	3.2	25	3.0	2.6	2.4	2.0	2.5
11	3.3	3.4	2.4	1.7	2.3	26	3.1	2.1	3.4	2.0	2.5
12	3.4	3.4	2.2	2.4	2.1	27	.....	2.0	3.4	2.0	2.5
13	3.0	3.4	2.1	2.5	2.0	28	.....	.....	.....	2.2	2.5
14	2.9	3.3	2.1	1.9	2.1	29	.....	.....	.....	.....	2.5
15	3.1	3.3	2.0	1.8	2.0	30	.....	.....	.....	.....	2.5
						31	.....	.....	.....	.....	2.5

NOTE.—Canal dry after August 20, 1907, and after

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Monthly discharge of Cook canal near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet)
	Maximum.	Minimum.	Mean.	
1907.				
July	12.0	1.5	6.58	405
August 1-20	8.6	.5	5.02	199
1908.				
April 8-30	37	2	17.5	708
May	32	2	17.1	1,050
June	28	1	7.30	434
July	13	.0	3.26	200
August	5	.0	1.58	97

NOTE.—These estimates are only approximate, owing to great and irregular fluctuation of daily stages.

MATHESON CANAL NEAR CHINOOK, MONT.

This station, which was established April 10, 1905, is located at a footbridge 200 feet below the head-gate near the main road, 3½ miles east of Chinook.

Discharge measurements of Matheson canal near Chinook, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	Stewart and Huch				0.0
April 25	A. F. Huch	11.0	15.3	3.23	13.9
May 4	do	8.0	6.86	2.16	4.5
May 11	do			1.85	a 5
May 13	J. E. Stewart	6.4	5.92	2.24	3.7
May 26	A. F. Huch	7.8	9.31	2.56	b 2
June 4	do	6.6	5.90	2.31	b 2.2
June 13	do	10.6	12.3	3.07	b 7.8
June 25	do	9.0	12.0	c 3.00	.6
July 7	do	8.0	6.18	2.37	.9
July 16	do	7.9	5.20	2.18	.6

a Estimated. c Backwater due to beaver dams.
b Measurement affected by growth in canal.

NOTE.—The station was visited by a hydrographer on May 10 and 25, June 4, July 6 and 27, and August 10, 1907, and each time there was no flow, as the water was standing in pools.

Mean daily gage height, in feet, of Matheson canal near Chinook, Mont., for 1907 and 1908.

[Herbert Reynolds, observer.]

Day.	Apr.	May.	June.	July.	Aug.
1908.					
1		2.4	2.4	2.6	2.5
2		2.4	2.3	2.6	2.5
3		2.6	2.4	2.6	2.5
4		2.5	2.5	2.5	
5		2.7	2.7	2.3	2.4
6					
7		1.9	2.8	2.4	2.3
8		1.9	2.3	2.4	2.1
9	2.1	1.9	2.3	2.3	2.1
10	2.3	1.7	2.1	2.2	2.2
11	1.9	1.1	1.7	2.2	2.2

Day.	Apr.	May.	June.	July.	Aug.
1908.					
16	2.4	2.6	2.1	2.1	2.4
17	2.4	2.2	2.1	2.1	2.3
18	2.3	2.2	2.1	2.0	2.3
19	2.9	2.3	2.1	2.0	2.3
20	2.5	2.2	2.1	2.0	2.3
21	2.4	1.9	2.1	1.9	2.3
22	2.5	2.0	1.9	1.9	2.3
23	2.9	2.1	1.9	1.9	2.3
24	2.5	2.5	2.5	2.0	2.4
25	2.2	2.6	2.7	2.1	2.3
26	2.4	2.4	2.1	2.1	2.2
27	2.4	2.4	2.1	2.1	2.2
28	2.4	2.4	2.1	2.1	2.2
29	2.4	2.4	2.1	2.1	2.2
30	2.4	2.6	2.1	2.1	2.2
31				2.1	2.2

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Monthly discharge of Matheson canal near Chinook, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1908.				
April 8–30	16	3	10.5	479
May	6	.0	2.97	183
June	8	1	3.77	224
July	2	.0	.419	26
August	3	.0	.806	50

NOTE.—There was practically no flow during 1907. The daily discharges were obtained by a direct comparison of discharge measurements and gage heights and the monthly estimates are only approximate.

HARLEM CANAL NEAR ZURICH, MONT.

This station, which was established in June, 1903, is located about 500 feet below the head-gates of the canal, 1½ miles southeast of the Great Northern Railway section house at Zurich. It is reached by driving from Chinook.

The canal was not in use in 1907, as the head works were out of order.

Discharge measurements of Harlem canal near Zurich, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 27	A. F. Huch	26.5	64.3	3.64	65.7
May 6	do	27	67.8	3.71	67.3
May 15	Stewart and Huch	27	67.7	3.55	61.1
May 25	A. F. Huch	27	63.8	3.70	57.7
June 2	do	27.5	76.5	4.08	78.7
June 12	do	27	65.4	3.26	44.7
June 24	do	15	13.7	1.30	5.3
July 6	do	24	47.4	2.49	27.4
July 17	do	25	57.5	3.00	31.0
August 6	do	16	23.2	2.41	[a]20.6

[a] Made by wading 50 feet below gage.

NOTE.—All measurements except that of August 6 were made from highway bridge 2 miles below gage.

Daily gage height, in feet, of Harlem canal near Zurich, Mont., for 1908.

[Joel Lean, observer.]

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	.....	3.60	3.90	.....	16	3.10	3.60	.....	3.10
2	.....	3.60	4.10	2.20	17	3.40	3.60	.....	3.00
3	.....	3.50	3.80	2.40	18	3.60	3.60	.....	3.00
4	.....	3.50	3.60	3.00	19	3.60	4.00	.....	3.00
5	.....	3.50	.....	2.70	20	3.70	4.00	.....	2.90
6	.....	3.60	.....	2.60	21	3.50	3.50	.....	2.60
7	2.80	3.70	.....	2.90	22	3.40	3.50	.....	3.00
8	3.00	3.60	.....	3.00	23	3.40	3.50	.....	3.10
9	3.10	3.50	.....	3.00	24	3.60	3.40	.....	.....
10	3.00	3.50	.....	3.00	25	3.60	3.70	.....	.....
11	2.90	3.40	.....	3.00	26	3.50	3.60	.....	.....
12				3.00	27	3.60	3.50	.....	.....
13				3.00	28	3.80	3.50	.....	.....
14					29	3.70	3.50	.....	.....
15						3.70	3.60	.....	.....
						.....	3.60	.....	.....

[illegible] observer moved away.

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Monthly discharge of Harlem canal near Zurich, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 7-30	71	12	49.0	2,330
May	78	50	59.8	3,680
June	79	3	32.2	1,920
July	31	14	27.6	1,700
August	24	5	13.5	830

NOTE.—These values of monthly discharge are approximate, owing to great and irregular fluctuation of the gage height due to canal regulation.

AGENCY DITCH NEAR HARLEM, MONT.

This station, which was established July 14, 1905, is located at the highway bridge about one-fourth mile below the head-gate. It is reached by driving 4 miles south from Harlem, Mont.

The head-gates were opened for the season April 21, 1908, but were closed again for repairs from May 4 to 17, and also June 13 to July 6. The ditch was emptied August 1, 1908, and later a small flow was admitted to furnish water for the steam plow, but not for irrigation.

Discharge measurements of Agency ditch near Harlem, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 18	J. B. Pierson				0.0
May 24	do				.0
July 11	do	16	12.3	2.58	6.9
July 19	do	24	46.9	4.40	19.2
August 2	do			4.38	.0
August 27	do		33.3	3.90	11.8
September 28	Robert Follansbee	20	28.2	3.72	19.4
1908.					
April 4	A. F. Huch			.33	.0
April 24	do	24	46.4	2.42	37.2
May 8	do	17	17.6	1.10	17.0
May 28	do	23	39.2	2.15	37.9
August 11	do	16	15.7	1.40	a 13.2

a Made by wading.

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Daily gage height, in feet, of Agency ditch near Harlem, Mont., for 1907 and 1908.

[J. W. Ijams and C. P. Wells, observers.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1907.					1907.				
1	.....	4.5	4.4	3.9	16	4.6	4.5	4.2	4.2
2	.....	4.5	4.4	3.9	17	4.7	4.5	4.2	4.2
3	.....	4.6	4.4	3.9	18	4.7	4.5	4.0	4.2
4	.....	4.5	4.3	3.9	19	4.65	4.8	4.0	4.0
5	.....	4.45	4.3	3.9	20	4.5	4.8	4.0	3.8
6	.....	4.4	4.3	3.9	21	4.5	4.8	4.0	3.8
7	.....	4.3	4.3	3.9	22	4.4	4.7	4.0	3.7
8	.....	4.35	4.3	4.0	23	4.5	4.7	4.0	3.7
9	.....	4.4	4.3	4.0	24	5.35	4.7	4.0	3.7
10	.....	3.7	4.3	4.0	25	6.6	4.6	4.0	3.7
11	.....	2.8	4.2	4.1	26	5.5	4.6	3.8	3.7
12	.....	4.0	4.2	4.1	27	5.5	4.5	3.8	3.7
13	.....	4.5	4.2	4.1	28	5.35	4.5	3.8	3.7
14	.....	4.8	4.2	4.1	29	4.5	4.4	3.8	3.7
15	.....	4.8	4.2	4.2	30	4.5	4.4	3.8	3.7
					31	.....	4.4	3.8	3.7

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1908.					1908.				
1	.....	2.20	2.05	.....	16	.....	.....	.....	3.55
2	.....	2.20	2.25	.....	17	.....	.....	.....	3.6
3	.....	2.20	2.50	.....	18	.....	2.30	.....	3.5
4	.....	1.65	2.75	.....	19	.....	2.45	.....	3.5
5	.....	.....	2.85	.....	20	.....	2.65	.....	3.45
6	.....	.....	2.95	.....	21	.....	2.80	.....	3.4
7	.....	.....	3.00	.....	22	1.30	2.75	.....	3.3
8	.....	.....	3.10	3.45	23	2.45	2.65	.....	3.3
9	.....	.....	3.10	3.5	24	2.60	2.45	.....	3.3
10	.....	.....	3.20	3.6	25	2.50	2.35	.....	3.3
11	.....	.....	3.20	3.7	26	2.45	2.30	.....	3.3
12	.....	.....	3.20	3.75	27	2.25	2.20	.....	3.3
13	.....	.....	.....	3.7	28	2.20	2.10	.....	3.3
14	.....	.....	.....	3.7	29	2.25	2.10	.....	3.3
15	.....	.....	.....	3.6	30	2.15	2.10	.....	3.3
					31	.....	2.10	.....	3.3

NOTE.—These gage heights are affected by the canal regulation.

FORT BELKNAP CANAL NEAR CHINOOK, MONT.

This station, which was established June 21, 1903, is located at the highway bridge about 500 feet below the head-gates of the canal, 8 miles east of Chinook.

The high water of June, 1908, washed out both the bridge and the gage. A new gage was installed on June 27, 1908, at a different datum, within a few feet of the site of the old gage.

A new bridge was built about one-fourth mile upstream from the site of the old one. Measurements can be made from this bridge only when the canal is running full. Wading measurements are made at a section about 300 feet downstream from the gage.

There was flow in the canal on the single days for which gage heights ar[illegible] During a few of the days when the canal was [illegible]t its high[illegible] to the flood in Milk River, the water was wasted, [illegible]but the [illegible] of the time from June 5 to 30 the water was used [illegible]for irri[illegible]

The [illegible] closed for the season September 22, 1907, and Septe[illegible]

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Discharge measurements of Fort Belknap canal near Chinook, Mont., for 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 14	J. B. Pierson	36	67.5	3.45	108
May 20	do	27	42.6	2.80	56.0
June 3	do	25	32.4	2.45	40.1
July 5	do	25	34.6	2.89	25.0
July 17	do	24	33.7	2.88	33.6
July 29	do	27	36.1	3.11	54.4
August 16	Follansbee and Pierson	32	48.6	3.45	66.9
August 19	J. B. Pierson	30	44.1	3.39	60.7
August 26	do	25	31.3	3.00	39.3
September 10	do	30	39.9	3.25	54.3
September 27	Robert Follansbee	15	12.2	2.10	7.7
1908.					
April 10	Stewart and Huch	18	18.9	2.47	22.4
April 23	A. F. Huch	38	66.2	3.70	106
May 7	do	38	60.9	3.69	88.3
May 16	do	38	61.7	3.69	97.7
May 23	do	40	63.4	3.78	109
June 1	do	41	66.4	3.82	108
August 4	do	33	51.9	2.91	a 63.4
August 12	do	33	53.0	2.99	a 69.1

a Made by wading.

Daily gage height, in feet, of Fort Belknap canal near Chinook, Mont., for 1907 and 1908.

[Bruce Glenn, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1907.						1907.					
1			2.8	3.4	3.3	16	2.9		2.9	3.4	2.4
2			2.9	3.3	3.4	17	2.9		2.9	3.5	2.4
3		2.45	2.9	3.2	3.4	18	2.9		2.9	3.5	2.6
4			2.9	3.2	3.4	19			2.9	3.5	2.6
5			2.9	3.2	3.2	20			2.8	3.5	2.5
6				3.5	3.2	21			2.9	3.5	2.5
7			2.9	3.5	3.2	22			3.0	3.4	
8			2.8	3.5	3.2	23			3.2	3.4	
9			2.8	3.5	3.0	24			3.2	3.2	
10			2.8	3.6	3.2	25			3.2	3.1	
11			3.1	3.6	3.0	26			3.2	3.1	
12	3.25		3.1	3.6	3.0	27			3.1	3.0	
13	3.4		3.1	3.6	2.4	28			3.1	3.0	
14	3.32		3.0	3.4	2.4	29			3.3	3.0	
15	3.1		3.0	3.4	2.4	30			3.5	3.0	
						31			3.5	3.4	

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1908.							1908.						
1		3.72	3.92	3.90	3.90	2.70	16	3.36	3.74		2.65		2.70
2		3.66	3.86	3.70	3.80	2.70	17	3.45			2.65	2.80	2.65
3			3.72	3.45	3.80	2.65	18	3.50	4.00		2.60	2.80	2.60
4		3.74	3.72		3.80	2.65	19	3.50	3.90		2.60	2.80	2.60
5		3.66		3.30	3.80	2.65	20	3.50	3.88		2.60	2.85	2.60
6		3.70		3.51	3.90		21	3.72	3.80		2.60	2.85	2.60
7		3.60		3.74	3.85	2.65	22	3.70	3.85		2.65	2.80	2.60
8		3.50		3.35	3.85	2.65	23	3.72	3.65		2.65		2.60
9		3.65		3.17		2.65	24	3.48			2.60	2.80	
10	2.65			3.28	3.80	2.60	25	3.50	3.79		2.60	2.80	
11	2.65	3.45		3.30	3.80	2.65	26	3.45	3.65		2.57	2.80	
12	2.70	3.55		3.17	3.75	2.65	27	3.47	3.67		2.55	2.80	
13	2.70	3.65		3.25	3.70		28	3.48	3.67		2.55	2.75	
14	2.60	3.68		3.45	3.70	2.65	29	3.52	3.65		2.55	2.75	
15	2.65	3.70		3.35	3.70	2.70	30	3.51	3.65		2.55		
							31		3.65		2.55	2.75	

Note.—Readings available from May 14 to June 30, 1907, although the table was filled in 1908.

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Monthly discharge of Fort Belknap canal near Chinook, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
1907.				
May 12–18	102	62	77.4	1,070
July	78	22	38.8	2,380
August	75	39	62.0	3,810
September 1–21	62	16	36.7	1,530
1908.				
April 10–30	120	22	105	4,370
May	126	76	102	6,270
June	110	85	87.7	5,220
July	109	70	90.4	5,560
August	70	52	60.4	3,710
September 1–23	56	43	46.2	2,110

NOTE.—These values of monthly discharge are only approximate owing to the great and irregular fluctuation of the gage height due to canal regulation.

WINTER-ANDERSON CANAL NEAR CHINOOK, MONT.

This station, which was established April 22, 1906, is located at the highway bridge 5 miles east of Chinook and one-half mile west of James Cook's ranch house.

The canal was not in use during the season of 1907.

The gage was washed out June 11, 1908 and the head-gates were so badly damaged that it was impossible for water to flow in the canal after June 24, 1908. There was little flow before May 20 and none after June 20, 1908.

Discharge measurements of Winter-Anderson canal near Chinook, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 7	Stewart and Huch	.....	.....	2.63	0.0
April 27[a]	A. F. Huch	.....	.....	3.20	.....
May 6[a]	....do	.....	.....	2.83	.....
May 15	Stewart and Huch	.....	.....	2.40	0
May 25[b]	A. F. Huch	5.5	6.6	3.19	2.1
June 2[c]	....do	13	11.2	3.5	5.8
June 12[b]	....do	5.5	8.2	.....	4.2
June 24	....do	.....	.....	.....	0

[a] Canal not in use.
[b] Measurement made at a flume about 1 mile below gage.
[c] Made by wading 25 feet above gage.

Daily gage height, in feet, of Winter-Anderson canal near Chinook, Mont., for 1908.

[Freddie Bosch, observer.]

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1	.....	.....	3.30	11	.....	.....	.....	21	.....	3.6	.....
2	.....	.....	3.65	12	.....	.....	.....	22	.....	3.5	.....
3	.....	3.10	3.50	13	.....	.....	.....	23	.....	3.4	.....
4	.....	3.20	3.48	14	.....	.....	.....	24	.....	3.3	1.1
5	.....	3.10	3.55	15	.....	.....	.....	25	3.1	3.3	1.1
6	.....	3.10	3.65	16	.....	.....	.....	26	3.2	3.3	1.1
7	.....	.....	3.72	17	.....	.....	.....	27	3.2	3.4	1.2
8	.....	.....	3.53	18	.....	.....	.....	28	3.1	3.3	1.2
9	.....	.....	3.0	19	.....	.....	.....	29	.....	3.1	1.3
10	.....	.....	.....	20	.....	.....	.....	30	.....	3.2	1.3
								31	.....	3.3	.....

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Monthly discharge of Winter-Anderson canal near Chinook, Mont., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 25–28			1.50	12
May, 16 days	7	1	3.12	99
June, 20 days	24	1	6.85	272

NOTE.—These values are only approximate owing to the great and irregular fluctuation in daily gage heights due to canal regulation.

ROCK CREEK CANAL NEAR HINSDALE, MONT.

This station, which was established July 5, 1905, is located about 300 feet below the head-gates of the canal and is reached by driving 3½ miles north from Hinsdale. It was discontinued December 31, 1907.

During the spring of 1907 the canal contained a large amount of water, owing to the fact that the head-gates had been washed out. This water was not used for irrigation until after July 12, 1907.

Discharge measurements of Rock Creek canal near Hinsdale, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 31	J. B. Pierson	12	12.0	2.00	3.1
August 28	do	5	1.9	1.80	2.8
October 21	do				a1.5

a Estimated.

Daily gage height, in feet, of Rock Creek canal near Hinsdale, Mont., for 1907.

[F. E. Halbert, observer.]

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1		3.1	11	1.8		21	1.8	
2	1.9	2.9	12	1.8		22	1.8	
3	1.9	2.9	13	1.8		23	1.8	
4	1.9	2.9	14	1.9		24	1.8	
5	1.8	2.9	15	1.9		25	1.8	
6	1.8	2.9	16	1.9		26	1.8	
7	1.8	2.9	17	1.9		27	1.8	
8	1.8	2.9	18	1.8		28	1.8	
9	1.8	2.8	19	1.8		29	1.8	
10	1.8	2.7	20	1.8		30	1.8	
						31	2.0	

NOTE.—Gage heights after August 30 affected by canal regulation.

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LITTLE PORCUPINE CREEK DRAINAGE BASIN.

LITTLE PORCUPINE CREEK NEAR FRAZER, MONT.

Little Porcupine Creek rises near the central-western part of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near Frazer, Mont.

The drainage area comprises a strip of land about 25 miles long, extending but a short distance back from the narrow valley bordering the stream. Except for a growth of cottonwood and willows the basin is without forestation.

The run-off comes from the melting snow in the spring and from heavy rains during the summer. During the greater part of the year the channel is dry, except for about one-half second-foot of water derived from springs near the mouth of the stream. The annual rainfall is about 13 inches. The stream is not used for diversion.

The only gaging station in this basin is about 2 miles south of Frazer, Mont. It was established July 13, 1908, to obtain data for use in connection with an irrigation project being constructed by the United States Reclamation Service for the Fort Peck Indians.

Discharge measurements of Little Porcupine Creek near Frazer, Mont., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 12[a]	A. F. Huch		0.2	1.42	0.4
August 14	Stewart and Huch	2.0	.62	1.41	.4

[a] Made by floats.

Daily gage height, in feet, of Little Porcupine Creek near Frazer, Mont., for 1908.

[T. C. Flynn, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.5	1.4	1.4	1.5	1.5	16	1.5	1.4	1.4	1.5	1.5	1.5
2	.....	1.5	1.4	1.4	1.5	1.5	17	1.5	1.4	1.4	1.5	1.4	1.5
3	.....	1.5	1.4	1.4	1.4	1.5	18	1.6	1.4	1.4	1.5	1.4	1.5
4	.....	1.4	1.4	1.4	1.4	1.5	19	1.6	1.4	1.4	1.5	1.4	1.5
5	.....	1.4	1.4	1.4	1.4	1.5	20	1.5	1.4	1.4	1.5	1.4	1.5
6	.....	1.4	1.4	1.4	1.4	1.5	21	1.4	1.4	1.4	1.5	1.4	1.5
7	.....	1.4	1.4	1.4	1.5	1.5	22	1.4	1.4	1.4	1.4	1.4	1.5
8	.....	1.4	1.4	1.4	1.5	1.5	23	1.4	1.4	1.4	1.4	1.4	1.5
9	.....	1.4	1.4	1.4	1.5	1.5	24	1.4	1.4	1.4	1.4	1.4	1.5
10	.....	1.4	1.4	1.4	1.4	1.5	25	1.4	1.4	1.4	1.4	1.4	1.5
11	.....	1.4	1.4	1.5	1.4	1.5	26	1.4	1.4	1.4	1.4	1.4	1.5
12	1.4	1.4	1.4	1.5	1.5	1.5	27	1.4	1.4	1.4	1.5	1.4	1.5
13	1.4	1.4	1.4	1.5	1.5	1.5	28	1.4	1.4	1.4	1.5	1.4	1.5
14	1.4	1.4	1.4	1.5	1.5	1.5	29		1.4	1.4	1.5	1.5	1.5
15	1.4	1.4	1.4	1.5	1.5	1.5	30			1.4	1.5	1.5	1.5
							31						

NOTE.—Ice conditions in December.

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WOLF CREEK DRAINAGE BASIN.

WOLF CREEK AT WOLF POINT, MONT.

Wolf Creek rises near the center of the Fort Peck Indian Reservation, flows southward, and enters Missouri River near the Wolf Point Agency. The drainage area comprises the central part of the Fort Peck Indian Reservation. The entire area with the exception of a narrow valley along the stream is a rolling prairie. The only forestation is the growth of willows and cottonwoods along the banks of the streams.

The run-off comes from the melting snow in the spring and heavy rains during the summer. The upper part of the channel is dry during the late summer and winter, but near the mouth the flow is kept up by springs. The annual rainfall is about 13 inches. The stream is not used for storage and the only diversion is that made by the Indian Agency ditch at Wolf Point, which diverts the entire flow during the low period.

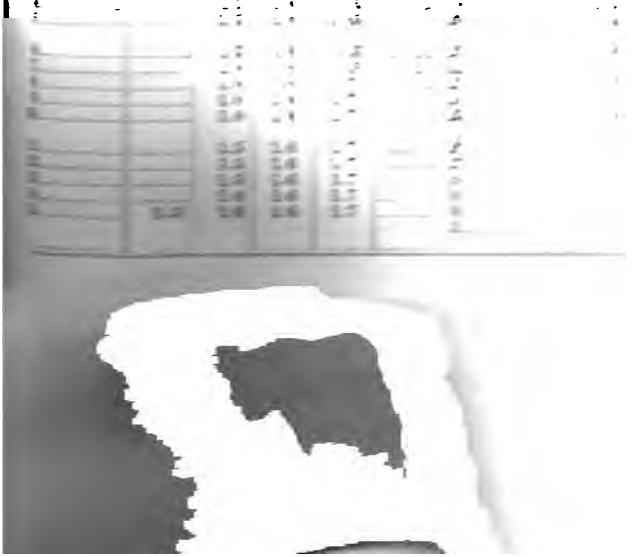
The gaging station, which was established August 15, 1908, to determine the amount of water available for an irrigation project under consideration by the United States Reclamation Service for the Fort Peck Indians, is located at William Smith's ranch, 2½ miles northwest of Wolf Point.

The following discharge measurement was made at this station:

August 17, 1908. Gage-height, 1.71 feet; discharge estimated as 0.2 second-foot.

Daily gage height, in feet, of Wolf Creek at Wolf Point, Mont., for 1908.

[W. H. Hunt, observer.]



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POPLAR CREEK DRAINAGE BASIN.

POPLAR CREEK NEAR POPLAR, MONT.

Poplar Creek rises in the southern part of the Canadian province of Saskatchewan, flows southeastward through the northern part of Valley County, Mont., thence through the Fort Peck Indian Reservation, and unites with Missouri River near Poplar, Mont. The largest tributary is the West Branch, which enters near the north boundary of the Fort Peck Reservation. The greater part of the drainage area is a rolling prairie cut by a number of small coulees and the valley of the creek. The only forestation is a growth of willows and cottonwoods along the banks of the stream.

The run-off comes from melting snow in the spring and heavy rains during the summer. The dry-season flow is considerable. The annual rainfall at Poplar is about 13 inches.

The United States Reclamation Service has under consideration a project which will divert the water of this stream to irrigate land along its lower course and along Missouri River near Poplar, Mont.

The gaging station was established August 15, 1908, at Buershia's ranch, 6 miles north of Poplar, Mont.

The following discharge measurement was made by wading at this station August 15, 1908:

Width, 31 feet; area of section, 7.30 square feet; gage height, 2.48 feet; and discharge, 9.9 second-feet.

Daily gage height, in feet, of Poplar Creek near Poplar, Mont., for 1908.

[R. W. Henry and Neol Buershia, observers.]

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	2.7	2.7	16	.....	2.65	2.9	.....
2	.....	2.5	2.7	2.7	17	2.9	2.55	2.9	.....
3	.....	2.9	2.7	2.7	18	2.9	2.55	2.9	.....
4	.....	2.9	2.7	2.7	19	2.9	2.5	3.0	.....
5	.....	2.9	2.7	2.7	20	2.9	2.45	3.0	.....
6	.....	2.9	2.7	2.7	21	2.9	2.4	3.0	.....
7	.....	2.9	2.7	2.7	22	2.9	2.4	3.0	.....
8	.....	2.9	2.95	2.7	23	2.9	2.4	3.0	.....
9	.....	2.9	2.95	2.7	24	2.9	2.4	3.0	.....
10	.....	2.9	2.95	2.7	25	2.9	2.4	3.0	.....
11	.....	2.9	2.8	2.7	26	2.5	2.4	3.0	.....
12	.....	2.9	2.95	.....	27	2.5	2.4	2.75	.....
13	.....	2.8	2.95	.....	28	2.5	2.4	2.7	.....
14	.....	2.7	2.95	.....	29	2.5	2.45	2.7	.....
15	.....	2.7	2.9	.....	30	2.5	2.45	2.7	.....
					31	2.5	.....	2.7	.....

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BIG MUDDY RIVER DRAINAGE BASIN.

BIG MUDDY RIVER NEAR CULBERTSON, MONT.

Big Muddy River rises in the Province of Saskatchewan, Canada, flows southward into Montana, forms the eastern boundary of the Fort Peck Indian Reservation, and unites with Missouri River near Blair, Mont. It drains a rolling prairie country cut by many small coulees. The greater part of the run-off comes from the melting snow in the spring months.

The gaging station, which was established July 14, 1908, to determine the amount of water available for irrigation projects under consideration by the United States Reclamation Service for the Fort Peck Indians, is located about 3 miles above the mouth of the stream.

Gage readings are affected by backwater from the Missouri, and are therefore not reliable except at low-water stage of the Missouri. Frequent discharge measurements are necessary in order to obtain good results.

The following discharge measurement was made by wading at this station August 16, 1908:

Width, 9 feet; area of section, 14.7 square feet; gage height, 1.7 feet; discharge, 6.3 second-feet.

Daily gage height, in feet, of Big Muddy River near Culbertson, Mont., for 1908.

[James Boyd, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	1.4	1.55	2.05	1.85	16	.....	1.7	1.3	1.75	1.9	.....
2	.....	.....	1.4	1.5	2.05	1.8	17	.....	1.7	1.25	1.8	1.9	.....
3	.....	.....	1.4	1.5	2.0	1.8	18	.....	1.65	1.25	1.8	1.9	.....
4	.....	.....	1.4	1.55	2.0	1.85	19	.....	1.6	1.3	1.75	1.95	.....
5	.....	.....	1.4	1.55	1.95	1.85	20	.....	1.6	1.3	1.85	1.95	.....
6	.....	.....	1.4	1.55	1.95	.....	21	.....	1.6	1.3	1.85	1.85	.....
7	.....	.....	1.4	1.55	2.0	.....	22	.....	1.6	1.3	1.85	1.85	.....
8	.....	.....	1.4	1.6	1.9	.....	23	.....	1.55	1.3	1.85	1.9	.....
9	.....	.....	1.4	1.65	2.0	.....	24	.....	1.55	1.3	1.9	1.95	.....
10	.....	.....	1.35	1.8	1.9	.....	25	.....	1.5	1.3	1.95	2.0	.....
11	.....	.....	1.35	1.8	1.9	.....	26	.....	1.5	1.3	1.85	2.25	.....
12	.....	.....	1.35	1.85	1.9	.....	27	.....	1.5	1.5	1.85	2.2	.....
13	.....	.....	1.35	1.85	1.9	.....	28	.....	1.45	1.55	1.95	1.95	.....
14	1.4	.....	1.35	1.85	1.9	.....	29	.....	1.45	1.55	2.0	1.85	.....
15	.....	.....	1.35	1.8	1.9	.....	30	.....	1.4	1.55	1.95	2.0	.....
							31	.....	1.4	.....	2.05	.....	.....

NOTE.—Ice conditions November 10 to 16 and December 5 to 31, 1908.

YELLOWSTONE RIVER DRAINAGE BASIN.

DESCRIPTION.

The upper Yellowstone rises in the Shoshone Mountains, in northwestern Wyoming, near the southeast corner of the Yellowstone National Park, flows northwestward for 40 or 50 miles, and then enters Yellowstone Lake, which may be considered the great source

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of the main river. This lake is about 15 miles long by 20 miles wide, lies at an elevation of 7,778 feet above the sea, and is hemmed in on every side by lofty mountains from whose snow-covered slopes its chief supply of water must come, since it receives no important streams. Issuing from the lake at the north end the river flows northwestward for 10 or 15 miles, plunges over the Great Falls of the Yellowstone, and for the next 20 miles runs through its "Grand Canyon," which is impassable throughout. About 80 miles from the lake it emerges from the Snow Mountains, and thence runs eastward and northeastward until it joins the Missouri at Fort Buford, N. Dak. At this point it has an elevation of about 1,900 feet.

As it leaves the mountains the river is about 600 feet wide; thence to Clark Fork, which enters from the south about 15 miles above Billings, Mont., it is characterized by bold, sweeping curves, and many islands. Between Clark Fork and the mouth of the Bighorn it is from 1,500 to 1,800 feet wide, is free from rapids, and has a current from 3 to 4 miles an hour. Between the Bighorn and the Powder the main stream increases in width from 2,400 to 2,700 feet, and becomes turbid like the Missouri. Below the mouth of the Powder the banks are low and caving and the stream contains some rapids and shoals and numerous densely timbered islands.

The Yellowstone is about 500 miles long; the area of its basin is approximately 67,500 square miles.

Of the tributaries of the Yellowstone the most important is the Bighorn,[a] which has its source in the many small streams draining the slopes of the Wind River Range. Other important tributaries of the Yellowstone are Shields, Boulder, Big Timber, Sweetgrass, Stillwater, Clark Fork, Tongue, and Powder rivers. Shields, Big Timber, and Sweetgrass rivers have their sources in the Crazy Mountains, rising to an elevation of 10,000 feet; the Boulder, Stillwater, and Clark Fork rise on the southeastern slope of the Shoshone Mountains at an elevation of 10,500 feet. Powder and Tongue rivers have their sources in the high plains region and Bighorn Mountains of Wyoming, flowing parallel and in a northeasterly direction until they join the Yellowstone.

The headwaters of the Yellowstone and many of its tributaries drain portions of heavily timbered areas. The Yellowstone, Crazy Mountain, Bighorn, and Otter national forests are thus drained. However, the greater part of the drainage basin lies within the plains section and is treeless except for a few willows and cottonwoods along the stream channels.

The mean annual rainfall in Yellowstone Park is approximately [illegible] at Bil[illegible]hes; Glendive, 10 inches; and at Buford

[a] For description of basin on p. 178.

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LOWER FALLS OF THE YELLOWSTONE, YELLOWSTONE NATIONAL PARK.

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Shoshone River near Lovell, Wyo., 1897–1899.
South Fork of Shoshone River at Marquette, Wyo., 1903–1908.
Little Bighorn River at Crow Agency, Mont., 1905–6.
Tongue River near Dayton, Wyo., 1903.
Big Goose Creek near Sheridan, Wyo., 1895–1897.
Little Goose Creek near Sheridan, Wyo., 1896–97.
Clear Creek at Buffalo, Wyo., 1896–1904.
Piney Creek at Kearney, Wyo., 1902–1906.
Cruez ditch near Story, Wyo., 1903.

YELLOWSTONE RIVER AT HUNTLEY, MONT.

This station, which is located at the new steel highway bridge 1 mile below Huntley, Mont., and replaces that formerly maintained at Junction, was established October 1, 1907, to obtain data applicable to irrigation and power development.

The only tributary near the station is Pryor Creek, which enters the Yellowstone 1 mile above. The drainage area at Huntley is about 12,000 square miles.

The Huntley canal (Pl. VI, *A*), built by the United States Reclamation Service, takes water from the river about 2 miles above the gaging station; its normal capacity is 400 second-feet, and it supplies water for 29,000 acres of land. Near Laurel are the headgates of the Billings Land and Irrigation Company's large canal, which carries about 305 second-feet and irrigates 28,000 acres. Many small ditches take water from the tributaries of the Yellowstone but few from the stream itself owing to the variation of the stages of the water surface and consequent difficulty in diversion.

This river freezes entirely over in places during the winter, but during the coldest seasons open channels with floating ice are not uncommonly seen. Conditions for obtaining accurate data at this station are only fair, as the channel is shifting and extra measurements are necessary to obtain a good rating curve. The gage datum has remained the same.

Discharge measurements of Yellowstone River at Huntley, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 1	J. E. Stewart	471	2,490	3.00	5,840
November 15	do	446	2,100	2.20	3,340
1908.					
March 28	J. E. Stewart	436	1,890	1.83	2,270
May 21	do	507	3,130	4.41	12,700
June 15	Raymond Richards	559	[a] 5,160	8.87	39,800
July 22	do	518	3,310	5.37	16,600
October 12	J. E. Stewart	446	1,740	2.67	5,000

[a] Area computed from soundings of July 22, 1908.

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A. MAIN CANAL, HUNTLEY PROJECT, MONTANA.

B. PRYOR CREEK WEIR DURING SPRING FLOOD, HUNTLEY PROJECT, MONTANA.

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Daily gage height, in feet, of Yellowstone River at Huntley, Mont., for 1907 and 1908.

[Jack O'Neil and Arthur Foster, observers.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1907.				1907.				1907.			
1	3.0	2.4	2.1	11	2.7	2.3	2.0	21	2.6	2.2	1.2
2	3.0	2.4	2.1	12	2.7	2.2	2.0	22	2.6	2.2	1.2
3	3.1	2.4	2.1	13	2.7	2.2	2.0	23	2.6	2.2	1.2
4	3.0	2.3	2.1	14	2.7	2.2	2.0	24	2.5	2.2	1.2
5	3.0	2.3	2.0	15	2.7	2.2	1.8	25	2.5	2.2	1.2
6	2.8	2.3	2.0	16	2.7	2.2	1.8	26	2.5	2.2	1.1
7	2.8	2.3	2.0	17	2.6	2.2	1.7	27	2.5	2.2	1.1
8	2.8	2.3	2.0	18	2.6	2.2	1.5	28	2.4	2.2	1.1
9	2.8	2.3	2.0	19	2.6	2.2	1.2	29	2.4	2.2	1.4
10	2.8	2.3	2.0	20	2.6	2.2	1.2	30	2.4	2.1	1.5
								31	2.4	.....	1.6

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	1.70	1.60	2.90	1.82	2.50	7.80	6.90	4.40	3.20	2.70	2.60	1.80
2	1.70	1.50	.....	1.78	2.50	8.00	7.60	4.40	3.20	2.70	2.60	1.50
3	1.70	1.50	.....	1.78	2.60	7.70	7.80	4.30	3.10	2.78	2.60	1.60
4	1.60	1.50	.....	1.70	3.07	7.90	7.80	4.20	3.00	2.00	2.60	2.00
5	1.60	1.70	2.40	1.69	3.40	6.70	7.60	4.20	3.00	2.98	2.60	2.00
6	2.00	1.90	.....	1.70	3.60	6.70	6.20	4.10	3.00	3.00	2.60	2.50
7	2.00	2.00	.....	1.70	3.70	6.70	6.20	3.90	3.00	2.96	2.60	2.20
8	2.00	2.10	2.40	1.70	4.03	6.90	7.40	3.80	3.00	2.90	2.58	2.25
9	2.00	2.20	.....	1.71	4.60	7.10	7.60	3.70	2.80	2.90	2.58	2.25
10	2.00	.....	.....	1.80	4.80	7.70	7.60	3.70	2.80	2.80	2.58	2.30
11	2.00	.....	.....	1.87	4.90	7.80	7.80	3.60	2.80	2.80	2.53	2.20
12	2.00	.....	2.50	1.92	4.80	7.80	7.50	3.60	2.80	2.67	2.53	2.10
13	2.00	.....	.....	1.94	4.00	8.80	7.50	3.90	2.80	2.67	2.53	2.10
14	2.00	.....	.....	1.97	3.80	9.00	7.20	3.90	2.80	2.67	2.50	2.10
15	2.00	.....	3.00	2.12	3.80	9.00	6.80	3.80	2.80	2.70	2.50	2.10
16	1.90	2.00	.....	2.30	3.73	9.00	6.80	3.80	2.76	2.71	2.50	2.00
17	1.90	.....	.....	2.45	3.84	9.10	6.30	3.80	2.76	2.90	2.50	2.00
18	1.90	.....	.....	2.53	3.60	9.00	6.20	3.80	2.76	2.97	2.56	1.80
19	1.90	2.40	2.90	2.60	3.60	8.50	6.00	3.70	2.76	3.00	2.50	1.70
20	2.20	2.40	.....	3.00	3.20	7.80	5.60	3.60	2.60	2.98	2.56	1.90
21	2.20	.....	.....	3.11	4.40	7.00	5.50	3.60	2.78	2.96	2.56	2.00
22	2.20	.....	1.85	3.13	3.98	7.00	5.40	3.60	2.78	2.96	2.30	1.95
23	2.20	2.10	1.85	3.70	4.10	6.80	5.36	3.50	2.78	2.94	2.28	1.95
24	2.20	.....	1.85	3.72	4.80	6.70	5.30	3.62	2.76	2.94	2.22	1.95
25	2.20	.....	1.85	3.70	4.00	6.50	5.20	3.50	2.70	2.90	2.20	2.10
26	2.20	.....	1.85	3.68	4.30	6.20	5.20	3.45	2.70	2.80	2.20	2.25
27	2.20	3.00	1.85	3.30	8.00	7.50	5.10	3.33	2.70	2.18	2.10	2.25
28	2.20	.....	1.85	3.10	7.65	8.40	5.10	3.22	2.70	2.88	2.10	2.20
29	2.00	.....	1.85	2.90	6.75	7.20	5.00	3.15	2.70	2.85	2.10	2.20
30	2.00	.....	1.85	2.50	6.10	7.05	4.90	3.20	2.70	2.84	2.00	2.00
31	1.90	.....	1.85	2.40	7.20	.....	4.80	3.20	.....	2.84	.....	1.90

NOTE.—Practically no ice during December, 1908.

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Rating table for Yellowstone River at Huntley, Mont., for October 1, 1907, to December 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	1,060	2.40	4,000	3.70	8,900	6.00	20,900
1.20	1,220	2.50	4,320	3.80	9,340	6.20	22,100
1.30	1,380	2.60	4,640	3.90	9,800	6.40	23,340
1.40	1,540	2.70	4,980	4.00	10,260	6.60	24,600
1.50	1,700	2.80	5,320	4.20	11,200	6.80	25,880
1.60	1,860	2.90	5,680	4.40	12,160	7.00	27,160
1.70	2,050	3.00	6,040	4.60	13,160	7.20	28,480
1.80	2,270	3.10	6,420	4.80	14,180	7.40	29,800
1.90	2,520	3.20	6,800	5.00	15,220	7.60	31,120
2.00	2,800	3.30	7,200	5.20	16,300	7.80	32,440
2.10	3,080	3.40	7,600	5.40	17,400	8.00	33,760
2.20	3,380	3.50	8,020	5.60	18,540	9.00	40,560
2.30	3,680	3.60	8,460	5.80	19,700	9.10	41,240

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1907–8 and is well defined.

Monthly discharge of Yellowstone River at Huntley, Mont., for 1907 and 1908.

[Drainage area, 12,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
October	6,420	4,000	4,930	0.411	0.47	303,000	A.
November	4,000	3,080	3,510	.292	.33	209,000	A.
December	3,080	1,060	2,110	.176	.20	130,000	B.
1908.							
January	3,380	1,860	2,790	.232	.27	172,000	C.
February	.....	.....	1,870	.156	.17	108,000	D.
March	.....	.....	1,880	.157	.18	116,000	D.
April	8,980	2,030	4,470	.372	.42	266,000	A.
May	33,800	4,320	12,700	1.06	1.22	781,000	A.
June	41,200	22,100	31,500	2.62	2.92	1,870,000	A.
July	32,400	14,200	23,400	1.95	2.25	1,440,000	A.
August	12,200	6,610	9,070	.756	.87	559,000	A.
September	6,800	4,640	5,450	.454	.51	324,000	A.
October	6,040	2,800	5,420	.452	.52	333,000	A.
November	4,640	2,800	4,140	.345	.38	246,000	B.
December	4,320	1,700	2,940	.245	.28	181,000	B.
The year	41,200	.....	8,900	.733	9.99	6,400,000	

YELLOWSTONE RIVER AT JUNCTION, MONT.

This station, which was established May 10, 1906, to take the place of the one maintained at Billings, is located at the county highway bridge at Junction, 1 mile north of Custer, Mont. The records furnish information of value in connection with irrigation projects. It was discontinued December 31, 1907, in favor of the station at Huntley.

The Bighorn, which joins the Yellowstone about 7 miles below the station, is the only important tributary near Junction. The drainage area is 13,500 square miles.

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No diversions are made from the Yellowstone itself near this station. The high banks and the variations in the height of the water surface make irrigation on a small scale impracticable.

Ice forms at this station, but records obtained during the open season were good. The channel shifts only in extreme high water. The gage datum remained unchanged.

Discharge measurements of Yellowstone River at Junction, Mont., in 1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	J. E. Stewart	394	2,130	3.56	3,480
May 30	do	596	3,420	5.76	13,600
June 23	do	609	5,400	9.10	[a] 37,700
July 11	do	608	5,490	9.74	38,800
August 15	do	450	3,310	5.41	11,600
November 16	do	384	2,430	3.71	3,520

[a] Measurement doubtful.

Daily gage height, in feet, of Yellowstone River at Junction, Mont., for 1907.

[J. E. Thurmond and Miss Nina Winter, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.45	.....	4.5	3.6	3.6	6.1	9.7	7.3	4.9	4.3	3.8	3.6
2	3.4	.....	4.5	3.7	3.7	6.8	9.5	7.0	4.8	4.2	3.7	3.6
3	3.45	.....	4.5	3.7	3.6	7.7	9.6	7.0	4.8	4.3	3.7	3.6
4	.....	.....	4.6	3.7	3.5	7.5	9.9	6.7	4.7	4.4	3.8	3.5
5	3.5	.....	4.7	3.7	3.5	7.2	10.6	6.7	4.7	4.3	3.8	3.5
6	.....	3.9	4.5	3.7	3.6	7.5	11.0	6.5	4.6	4.3	3.8	3.5
7	.....	.....	4.3	3.7	3.6	7.9	10.5	6.5	4.6	4.2	3.8	3.5
8	.....	.....	4.3	3.7	3.7	8.2	9.7	6.3	4.6	4.1	3.8	3.5
9	3.5	.....	4.5	3.8	3.7	8.6	9.6	6.2	4.7	4.1	3.7	3.5
10	.....	4.2	4.3	3.8	3.8	8.5	10.3	6.0	4.6	4.1	3.7	3.5
11	.....	4.4	4.1	3.8	4.0	7.9	9.7	6.0	4.5	4.1	3.7	3.5
12	.....	4.7	3.9	3.9	4.2	7.9	9.2	5.8	4.5	4.0	3.7	3.5
13	.....	4.8	3.9	3.9	4.5	8.2	9.1	5.8	4.5	4.0	3.6	3.5
14	.....	5.0	3.9	3.9	4.4	8.2	9.1	5.6	4.5	4.0	3.6	3.5
15	.....	5.6	3.8	4.0	4.2	7.8	9.1	5.6	4.5	4.0	3.6	.....
16	.....	6.0	3.8	4.0	4.1	7.6	9.4	5.4	4.4	4.0	3.7	.....
17	3.0	6.0	3.7	4.0	4.3	7.4	8.5	5.4	4.4	4.0	3.7	3.5
18	.....	5.8	3.7	4.0	5.6	7.4	8.1	5.2	4.3	3.9	3.7	3.5
19	.....	5.6	3.6	3.9	5.8	7.5	8.1	5.3	4.3	3.9	3.7	3.5
20	.....	5.4	3.6	3.9	6.0	7.6	8.4	5.1	4.2	3.9	3.7	3.5
21	.....	5.0	3.6	3.9	6.2	8.2	8.8	5.1	4.2	3.9	3.6	3.5
22	.....	4.8	3.55	3.8	6.4	8.6	8.7	4.9	4.1	3.9	3.6	3.5
23	.....	4.9	3.55	3.8	6.6	9.6	8.5	4.9	4.1	3.9	3.6	3.4
24	3.1	4.9	3.5	3.8	6.7	9.9	8.6	4.7	4.1	3.9	3.6	3.4
25	.....	4.8	3.5	3.7	6.9	8.9	8.4	4.8	4.0	3.9	3.6	3.4
26	.....	4.7	3.45	3.6	6.6	8.2	8.1	4.8	4.0	3.9	3.6	3.4
27	.....	4.5	3.45	3.6	6.3	7.2	7.8	5.0	4.1	3.9	3.6	3.4
28	.....	4.5	3.5	3.6	6.1	8.1	7.4	4.9	4.1	3.9	3.6	3.5
29	.....	.....	3.5	3.5	5.9	9.1	7.25	5.0	4.4	3.8	3.6	3.5
30	3.45	.....	3.5	3.5	5.9	9.4	7.5	5.0	4.4	3.8	3.6	3.5
31	.....	.....	3.5	.....	5.9	.....	7.4	5.0	.....	3.9	.....	.....

NOTE.—River frozen over January 3 to March 19. Above the gage the river was frozen entirely across, but below there was some open water because of rapids.
From January 3 to February 20 the river was frozen at the gage.

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Rating table for Yellowstone River at Junction, Mont., for 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	2,740	4.80	8,390	6.20	16,240	8.20	28,840
3.50	3,060	4.90	8,890	6.30	16,850	8.40	30,180
3.60	3,390	5.00	9,400	6.40	17,460	8.60	31,520
3.70	3,730	5.10	9,910	6.50	18,080	8.80	32,860
3.80	4,080	5.20	10,430	6.60	18,700	9.00	34,200
3.90	4,440	5.30	10,960	6.70	19,320	9.20	35,600
4.00	4,820	5.40	11,500	6.80	19,940	9.40	37,000
4.10	5,220	5.50	12,050	6.90	20,570	9.60	38,400
4.20	5,640	5.60	12,620	7.00	21,200	9.80	39,800
4.30	6,060	5.70	13,210	7.20	22,460	10.00	41,200
4.40	6,500	5.80	13,810	7.40	23,720	11.00	48,400
4.50	6,960	5.90	14,410	7.60	24,980		
4.60	7,420	6.00	15,020	7.80	26,240		
4.70	7,900	6.10	15,630	8.00	27,500		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907, and is fairly well defined.

Monthly discharge of Yellowstone River at Junction, Mont., for 1907.

[Drainage area, 13,500 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Acre-feet.	
January			a 1,500	0.111	0.13	92,200	D.
March 19–31	3,390	2,900	3,140	.233	.11	81,000	B.
April	4,820	3,060	4,000	.296	.33	238,000	A.
May	20,600	3,060	9,800	.726	.84	603,000	A.
June	40,500	15,600	27,800	2.06	2.30	1,650,000	A.
July	48,400	22,800	34,400	2.56	2.95	2,120,000	A.
August	23,100	7,900	13,200	.978	1.13	812,000	A.
September	8,890	4,820	6,630	.490	.55	395,000	A.
October	6,500	4,080	4,930	.365	.42	303,000	A.
November	4,080	3,390	3,650	.270	.30	217,000	B.
December	3,390	2,740	3,040	.225	.26	187,000	C.
The period						6,700,000	

a Estimated.

YELLOWSTONE RIVER AT GLENDIVE, MONT.

This station, which was established in 1893 by the United States War Department, was transferred to the Department of Agriculture, which has kept daily records of river height. When a study of the Lower Yellowstone Valley was begun in 1903 the station was taken up by the United States Geological Survey, whose records begin August 1, 1903. The station is located at the steel highway bridge leading northward from Glendive, about one-fourth mile from the post-office. The records are used to determine the amount of water available for the lower Yellowstone project and other irrigation [illegible]es. The drainage area of Yellowstone River at Glendive is [illegible]uare miles.

[illegible]ly large diversion from the Yellowstone near Glendive is [illegible] Yellowstone canal, built by the United States Reclamation

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PORTION OF COMPLETED MAIN CANAL, LOWER YELLOWSTONE PROJECT, MONTANA.

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Service. It leaves the river 18 miles below Glendive and diverts water to irrigate 66,000 acres of land. (See Pl. VII.)

Since 1903 no change in gage datum has been made. The records obtained at this station are good during the open season. Although in low water the old piling and cribwork of a former bridge somewhat obstruct the flow. Ice exists from December to April.

Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1907 and 1908.

[Howard Roby, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	7.75	1.75	2.0	5.8	9.0	7.35	3.9	2.6	1.9	1.4
2	.....	.....	7.3	1.9	1.9	5.8	9.15	7.25	3.9	2.6	1.9	1.3
3	.....	.....	6.95	2.0	1.9	5.85	9.4	6.95	3.95	2.75	1.8	1.3
4	.....	.....	6.65	1.9	1.8	6.2	9.4	6.85	3.95	2.8	1.8	1.4
5	.....	.....	6.7	1.85	1.8	7.2	9.65	6.65	3.7	2.8	1.8	1.4
6	.....	.....	6.45	1.75	1.8	7.3	9.95	6.6	3.55	2.9	1.8	1.2
7	.....	.....	6.55	1.7	1.75	7.2	10.3	6.7	3.45	2.7	1.75	1.15
8	.....	.....	6.9	1.7	1.7	7.8	10.7	6.3	3.35	2.6	1.7	1.2
9	.....	.....	6.8	1.6	1.7	8.6	10.5	6.15	3.3	2.5	.....	1.15
10	.....	.....	6.65	1.6	1.7	9.1	10.15	5.95	3.4	2.5	1.65	1.1
11	.....	.....	6.65	1.5	1.7	9.2	10.4	5.8	3.35	2.5	1.6	1.0
12	.....	.....	6.7	1.4	1.8	9.0	10.5	5.65	3.3	2.35	1.55	1.2
13	.....	.....	6.55	1.3	2.25	8.4	9.85	5.55	3.25	2.3	1.5	.....
14	.....	.....	6.4	1.3	2.75	8.2	9.4	5.45	3.2	2.3	1.45	.....
15	.....	.....	6.1	1.45	3.75	8.5	9.2	.....	3.2	2.3	1.4	.....
16	.....	.....	6.2	1.7	3.95	8.75	9.2	4.85	3.15	2.25	1.35	.....
17	.....	.....	6.0	1.7	3.6	8.2	9.4	4.75	3.05	2.3	1.3	.....
18	.....	.....	6.1	1.95	3.6	7.95	9.3	4.5	2.95	2.25	1.35	.....
19	.....	.....	6.2	2.3	3.55	7.55	8.4	4.4	2.85	2.1	1.4	.....
20	.....	8.7	6.15	2.4	4.6	7.1	7.95	4.25	2.85	2.1	1.5	.....
21	.....	8.55	6.7	2.4	5.05	7.3	8.4	4.2	3.0	2.1	1.5	.....
22	.....	7.9	7.45	2.3	5.45	8.0	8.15	4.15	3.05	2.05	1.5	.....
23	.....	7.85	7.05	2.25	6.05	9.5	8.25	4.05	3.3	2.0	1.5	.....
24	.....	7.8	3.6	2.1	6.75	10.9	8.1	3.9	3.3	2.0	1.4	.....
25	.....	8.7	3.3	1.95	8.2	10.8	8.1	3.8	2.85	2.0	1.4	.....
26	.....	8.35	2.9	1.9	9.1	10.15	8.05	3.7	2.55	2.0	1.4	.....
27	.....	8.05	2.8	1.95	8.9	8.85	7.8	3.6	2.5	1.9	1.35	.....
28	.....	8.0	2.55	2.0	8.2	8.2	7.5	4.05	2.4	1.9	1.3	.....
29	.....	.....	2.25	2.05	7.25	7.45	7.4	4.4	2.4	1.9	1.3	.....
30	.....	.....	2.15	2.05	6.5	8.15	7.15	4.05	2.4	1.9	1.4	.....
31	.....	.....	1.95	.....	6.0	.....	7.15	3.95	.....	1.9	.....	.....
1908.												
1	.....	2.6	.....	.....	2.75	7.05	8.1	5.2	3.25	2.3	2.3	6.0
2	.....	.....	.....	.....	2.55	7.7	7.7	5.05	3.2	2.2	2.3	5.8
3	.....	.....	.....	.....	2.4	8.35	8.0	4.85	3.05	2.3	2.25	6.25
4	4.9	2.3	.....	.....	2.3	9.7	8.3	4.75	3.0	2.55	2.2	5.6
5	.....	.....	.....	.....	2.2	10.0	8.45	4.6	2.9	2.9	2.15	5.8
6	.....	.....	.....	.....	2.5	9.2	8.75	4.55	2.8	3.25	2.1	5.7
7	.....	.....	.....	.....	2.95	8.6	9.25	4.35	2.7	3.0	2.1	6.13
8	.....	.....	.....	1.45	3.05	8.15	9.3	4.2	2.55	3.0	.....	6.3
9	.....	.....	3.8	1.4	3.1	7.6	8.5	4.1	2.4	2.95	2.0	.....
10	.....	.....	.....	1.25	3.75	7.45	8.35	3.95	2.3	2.8	2.0	.....
11	4.9	.....	.....	1.1	4.55	8.05	8.35	3.8	2.3	2.7	2.2	.....
12	.....	.....	4.55	1.0	4.95	8.35	8.4	3.7	2.3	2.6	2.3	.8
13	.....	.....	.....	.9	4.95	8.55	8.45	3.7	2.2	2.6	2.0	.....
14	4.6	.....	5.6	.9	4.7	8.75	8.25	3.85	2.2	2.5	1.65	.....
15	.....	.....	.....	1.0	4.4	9.35	8.1	3.9	2.2	2.5	1.5	.....
16	.....	.....	.....	1.15	4.15	9.75	8.1	3.95	2.1	2.55	.6	7.8
17	.....	.....	.....	1.35	4.05	10.2	8.0	3.9	2.15	2.8	.9	.....
18	3.6	.....	5.4	1.7	4.0	10.6	7.6	4.25	2.3	2.75	1.55	.....
19	.....	.....	.....	2.0	4.0	10.5	7.4	4.35	2.3	2.9	.....	6.5
20	.....	.....	5.8	2.15	.....	10.35	6.95	4.3	2.25	3.2	.....	.....
21	3.9	.....	.....	2.35	4.15	9.85	6.6	4.0	2.45	3.15	.....	.....
22	.....	.....	.....	2.55	5.1	9.25	6.25	4.35	2.3	2.95	.....	.....
23	.....	.....	6.05	2.8	6.2	8.55	6.1	4.45	2.2	2.8	1.8	6.3
24	.....	.....	.....	3.05	6.95	7.9	6.05	4.15	2.1	2.65	2.0	.....
25	4.1	.....	.....	3.9	6.75	7.85	5.9	4.1	2.05	2.55	2.25	.....

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Daily gage height, in feet, of Yellowstone River at Glendive, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
26				4.0	6.85	7.6	5.9	4.0	2.1	2.5	2.2	6.4
27				3.95	6.65	7.35	5.8	4.0	2.2	2.5	2.25	.....
28	3.7			3.7	5.9	7.75	5.65	3.95	2.2	2.5	2.25	.....
29			4.2	3.35	7.8	8.5	5.55	3.75	2.2	2.4	2.3	.....
30				3.05	7.9	8.85	5.7	3.55	2.25	2.35	1.85	6.6
31					7.1		5.25	3.35		2.3		

NOTE.—Ice conditions January 1 to March 23, December 13 to 31, 1907. River frozen entirely across with no anchor ice January 1 to February 13, 1907; ice broke up and went out February 14 to 19. February 25 to March 23, 1907, ice jam at gage; gage reading to top of ice; ice went out March 23.
Ice conditions January 1 to April 7, December 1 to 31, 1908; gage readings are to water surface.

Rating table for Yellowstone River at Glendive, Mont., for 1906 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	4,640	2.20	7,860	3.50	12,900	5.60	25,900
1.00	4,860	2.30	8,160	3.60	13,380	5.80	27,500
1.10	5,080	2.40	8,480	3.70	13,880	6.00	29,200
1.20	5,300	2.50	8,820	3.80	14,360	6.20	31,000
1.30	5,530	2.60	9,180	3.90	14,880	6.40	32,900
1.40	5,780	2.70	9,540	4.00	15,400	6.60	34,900
1.50	6,060	2.80	9,920	4.20	16,500	6.80	37,000
1.60	6,340	2.90	10,300	4.40	17,650	7.00	39,200
1.70	6,620	3.00	10,700	4.60	18,850	8.00	50,900
1.80	6,740	3.10	11,120	4.80	20,150	9.00	64,000
1.90	7,030	3.20	11,540	5.00	21,500	10.00	78,000
2.00	7,300	3.30	11,960	5.20	22,980	11.00	92,000
2.10	7,580	3.40	12,440	5.40	24,300		

NOTE. The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during [illegible] and is well defined between gage heights 1.3 feet and 8.0 feet. Below gage height 2.4 feet it is the same as the 1905 table.

Monthly Discharge of Yellowstone River at Glendive, Mont., for 1907 and 1908.

[Drainage area, 68,100 square miles.]

Month.	Discharge in second-feet.				Run-off.		
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	Accuracy.
[illegible]							
						154,000	A.
						413,000	A.
						1,270,000	A.
						3,170,000	A.
						3,940,000	B.
						1,480,000	A.
						880,000	A.
						585,000	A.
						383,000	B.
						135,000	B.
						12,160,000	
						385,000	A.
						1,320,000	A.
						3,620,000	B.
						2,750,000	A.
						1,490,000	A.
						521,000	A.
						364,000	A.
						153,000	B.
						30,360,000	

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NORTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, is located 1 mile above the Tintinger ranch, 15 miles northwest of Big Timber, just above the junction with the South Fork.

The source of North Fork is two lakes in the Crazy Mountains. These lakes form excellent reservoir sites. It is proposed to utilize the flow of the North Fork in connection with a project under the Carey land act. The drainage area above the station is only 40 square miles.

Several ditches above the station divert water to irrigate approximately 300 acres of land. A large ditch appropriating 50,000 inches of water has its head-gate just below the gage. This appropriation includes both forks. The water rights on Big Timber Creek have never been adjudicated.

At the gaging station the bed of the stream is composed of bowlders and coarse gravel, and is probably permanent. Results obtained during the open season are good.

Discharge measurements of North Fork of Big Timber River near Big Timber, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Robert Fellansbee	30	23.8	1.10	30.9
May 31	do	37	43.6	1.75	118
September 27	J. E. Stewart	24	20.2	.94	21.5
1908.					
May 13	Raymond Richards	24	19.9	1.28	33.8
May 25	J. E. Stewart	27.5	31.7	1.37	47.6
July 24	Raymond Richards	38	36.8	1.70	90.3
October 7	J. E. Stewart	19	13.4	1.18	27.2

Daily gage height, in feet, of North Fork of Big Timber River near Big Timber, Mont., for 1907 and 1908.

[N. J. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1				2.12	2.35	1.78	1.11	1.05	0.95
2				2.22	2.40	1.78	1.11	1.00	.95
3				2.18	2.45	1.82	1.11	1.15	.95
4				1.92	2.60	1.72	1.11	1.05	.95
5				2.00	2.45	1.65	1.11	1.00	.95
6				2.28	2.35	1.60	1.11	1.00	.95
7			1.30	2.32	2.15	1.60	1.11	.90	.95
8			1.32	2.18	2.30	1.60	1.10	.90	.95
9			1.32	1.98	2.30	1.62	1.15	.90	.95
10			1.30	1.92	2.10	1.95	1.10	.90	.....
11			1.42	1.65	2.05	1.75	1.10	.90	.....
12			1.57	1.90	2.05	1.65	1.05	.90	.....
13			1.45	2.08	2.30	1.65	1.05	.90	.....
14			1.35	2.18	2.35	1.68	1.05	.90	.....
15			1.41	2.00	2.20	1.65	1.00	.90	.....

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Daily gage height, in feet, of North Fork of Big Timber River near Big Timber, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
16			1.50	1.78	2.28	1.45	1.00	.90	
17			1.90	1.82	2.20	1.45	1.00	.85	
18			1.98	2.00	2.10	1.38	.92	.85	
19			2.30	2.45	2.05	1.32	.92	.85	
20			2.62	2.48	2.38	1.28	.90	.85	
21			2.42	2.35	2.30	1.22	.90	.85	
22			2.05	2.28	2.25	1.22	.90	.85	
23			1.70	2.45	2.05	1.22	.90	.85	
24			1.68	2.15	1.98	1.22	.90	.85	
25			1.58	2.10	1.92	1.18	.90	.85	
26			1.60	2.00	1.90	1.18	.90	.85	
27			1.60	2.35	1.95	1.18	.90	.85	
28			1.60	2.65	1.95	1.18	.90	.85	
29			1.72	2.68	2.00	1.18	1.05	.85	
30			1.72	2.50	2.05	1.16	1.00	.85	
31			1.90		1.82	1.15		.85	
1908.									
1		0.90	1.20	4.05	2.00	1.53	1.10	1.15	
2		.88	1.20	4.05	1.90	1.50	1.10	1.15	
3		.80	1.25	4.05	2.25	1.50	1.10	1.15	
4		.80	1.32	3.70	2.30	1.50	1.10	1.10	
5		.85	1.35	3.10	2.25	1.50	1.10	1.10	
6		.90	1.38	3.10	2.00	1.50	1.10	1.10	
7		.90	1.45	3.10	1.85	1.45	1.10	1.05	
8		.90	1.75	3.05	2.35	1.45	1.10	1.05	
9		.90	1.90	3.15	2.35	1.45	1.10	1.05	
10		.95	1.70	3.40	2.25	1.50	1.10	1.05	
11		.92	1.30	3.00	2.00	1.50	1.10	1.05	
12		.95	1.30	2.85	1.95	1.00	1.10	1.05	
13		1.00	1.30	2.65	2.30	1.65	1.10	1.05	
14		1.05	1.25	2.55	1.90	1.65	1.10	1.05	
15		.95	1.30	2.75	1.75	1.60	1.10	1.20	
16		1.00	1.30	3.00	1.60	1.00	1.10	1.25	
17		1.00	1.30	3.05	1.70	1.55	1.10	1.25	
18		1.00	1.35	3.20	1.65	1.00	1.10	1.25	
19		1.00	1.40	3.05	1.65	1.00	1.10	1.25	
20		1.00	1.35	2.90	1.70	1.00	1.10	1.20	
21		1.00	1.35	1.90	1.70	1.55	1.10	1.20	
22		1.00	1.30	1.90	1.70	1.55	1.10	1.15	
23		1.00	1.30	1.90	1.70	1.45	1.10	1.25	
24		1.00	1.30	1.90	1.65	1.25	1.10	1.25	
25		1.00	1.30	1.90	1.65	1.25	1.15		
26		1.00	1.30	1.90	1.70	1.20	1.15		
27		1.00	1.30	1.90	1.70	1.15	1.15		
28		1.00	1.30	1.90	1.70	1.10	1.10		
29		1.00	1.30	1.90	1.70	1.10	1.10		
30		1.00	1.30	1.90	1.70	1.05	1.10		
31			1.30		1.70	1.15	1.15		

[illegible] North Fork of Big Timber River near Big Timber, Mont.

[illegible]

[illegible]	Gage height.	Discharge.
[illegible]	Feet.	Sec.-ft.
[illegible]	[illegible]	388
[illegible]	[illegible]	344
[illegible]	[illegible]	328
[illegible]	[illegible]	486

[illegible] It is based on three [illegible] It is not well defined.

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Rating tables for North Fork of Big Timber River near Big Timber, Mont.—Continued.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	10	1.60	73	2.50	314	3.40	650
.80	12	1.70	90	2.60	350	3.50	688
.90	15	1.80	110	2.70	386	3.60	726
1.00	19	1.90	133	2.80	423	3.70	764
1.10	24	2.00	158	2.90	460	3.80	802
1.20	30	2.10	185	3.00	498	3.90	840
1.30	37	2.20	214	3.10	536	4.00	878
1.40	46	2.30	245	3.20	574	4.10	916
1.50	58	2.40	278	3.30	612		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on ten discharge measurements made during 1908–9, and is well defined between gage heights 0.75 foot and 2.1 feet Above gage height 2.1 feet it has been extended and is only approximate.

Monthly discharge of North Fork of Big Timber River near Big Timber, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 7–31	387	48	121	6,000	A.
June	409	97	236	14,000	A.
July	390	135	240	14,800	A.
August	168	34	74.9	4,610	A.
September	34	19	25.2	1,500	B.
October	34	18	20.0	1,230	C.
November 1–9	18	18	18.0	321	C.
The period				42,500	
1908.					
March 22–31	15	11	12.4	246	C.
April	48	12	23.3	1,390	A.
May	278	30	71.5	4,400	A.
June	897	58	383	22,800	B.
July	262	66	132	8,120	A.
August	82	19	54.7	3,360	A.
September	27	24	24.3	1,450	B.
October 1–24	34	22	27.1	1,290	B.
The period				43,100	

SOUTH FORK OF BIG TIMBER CREEK NEAR BIG TIMBER, MONT.

This station, which was established May 6, 1907, to determine the amount of water available for irrigation in connection with a Carey Land Act project, is located 1 mile above Tintinger's ranch, 15 miles northwest of Big Timber. The station is just above the junction with the North Fork.

The drainage area above the station is about 10 square miles. A few diversions are made, and practically all the water is appropriated.

Ice forms during the winter months. The channel is practically permanent and fairly good results have been obtained during the open season.

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Discharge measurements of South Fork of Big Timber Creek near Big Timber, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	Robert Follansbee	24	13.0	0.52	17.1
May 31	do	27	24.4	.95	73.1
September 27	J. E. Stewart	14	9.7	.59	18.2
1908.					
May 13	Raymond Richards	22	14.8	.70	25.4
May 25	J. E. Stewart	24	17.2	.80	42.5
July 24	Raymond Richards	21.5	18.5	.89	30.0
October 7	J. E. Stewart	13	8.75	.51	10.4

NOTE.—These measurements were made by wading at different sections.

Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1907 and 1908.

[N. J. Tintinger, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1				1.18	1.30	1.02	0.55	0.40	0.35
2				1.25	1.35	.95	.55	.60	.35
3				1.20	1.40	1.00	.55	.60	.35
4				.98	1.52	1.10	.55	.60	.35
5				.98	1.45	1.05	.55	.58	.35
6				1.15	1.35	1.05	.55	.58	.35
7			0.35	1.10	1.35	1.05	.55	.50	.35
8			1.12	1.12	1.35	1.02	.50	.40	.35
9			1.15	1.20	1.45	1.00	.50	.40	.35
10			.92	.92	1.30	1.35	.50	.40	.....
11			.95	.95	1.08	1.15	.45	.40	.....
12			.98	.98	1.15	.98	.45	.40	.....
13			1.10	1.10	1.40	.90	.45	.40	.....
14			1.12	1.12	1.30	.85	.45	.40	.....
15			1.22	1.22	1.11	.82	.35	.40	.....
16			[illegible]	[illegible]	1.11	.82	.32	.35	.....
17			[illegible]	[illegible]	1.11	.80	.30	.35	.....
18			[illegible]	[illegible]	1.05	.80	.30	.35	.....
19			[illegible]	[illegible]	1.05	.80	.30	.35	.....
20			[illegible]	[illegible]	1.05	.80	.30	.35	.....
21			[illegible]	[illegible]	1.05	.80	.30	.35	.....
22			[illegible]	[illegible]	1.05	.80	.30	.35	.....
23			[illegible]	[illegible]	1.05	.80	.30	.35	.....
24			[illegible]	[illegible]	1.05	.80	.30	.35	.....
25			[illegible]	[illegible]	1.05	.80	.30	.35	.....
26			[illegible]	[illegible]	1.05	.80	.30	.35	.....
27			[illegible]	[illegible]	1.05	.80	.30	.35	.....
28			[illegible]	[illegible]	1.05	.80	.30	.35	.....
29			[illegible]	[illegible]	1.05	.80	.30	.35	.....
30			[illegible]	[illegible]	1.05	.80	.30	.35	.....
31			[illegible]		1.05	.80		.35	.....
1908.									
1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.40	.....
2		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.40	.....
3		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.40	.....
4		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
6		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
7		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
8		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
9		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
10		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
11		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
12		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
13		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
14		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
16		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
17		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
18		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
19		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
20		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
21		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
22		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
23		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
24		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
25		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
26		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
27		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
28		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
29		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
30		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.30	.35	.....
31		[illegible]	[illegible]		[illegible]	[illegible]		.35	.....

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Daily gage height, in feet, of South Fork of Big Timber Creek near Big Timber, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
21	.....	.75	.35	1.40	1.00	.45	.55	.55	.....
22	0.30	.80	.30	1.35	1.00	.40	.55	.55	.....
23	.25	.72	.30	1.15	1.00	.35	.55	.60	.....
24	.25	.72	.35	1.10	.95	.35	.55	.60	.....
25	.28	.62	.45	1.15	.90	.45	.60	.....	.....
26	.25	.60	.85	1.10	.85	.35	.60	.....	.....
27	.25	.60	1.20	1.10	.85	.35	.60	.....	.....
28	.25	.55	1.10	1.00	.85	.35	.60	.....	.....
29	.25	.52	1.10	.85	.80	.30	.55	.....	.....
30	.32	.58	1.05	.75	.80	.30	.55	.....	.....
31	.35	.....	1.05	.....	.80	.45	.....	.....	.....

Rating tables for South Fork of Big Timber Creek near Big Timber, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	2	0.70	31	1.20	140	1.70	305
.30	4	.80	44	1.30	171	1.80	340
.40	8	.90	62	1.40	203		
.50	13	1.00	85	1.50	236		
.60	21	1.10	111	1.60	270		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on three discharge measurements made during 1907 and is not well defined.

FOR 1908.

0.30	3	0.90	48	1.50	212	2.10	412
.40	6	1.00	68	1.60	244	2.20	446
.50	10	1.10	92	1.70	277	2.30	480
.60	15	1.20	119	1.80	310	2.40	515
.70	23	1.30	149	1.90	344	2.50	550
.80	33	1.40	180	2.00	378		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on ten discharge measurements made during 1908-9, and is well defined below gage height 1.1 feet. Above this the table is only approximate.

Monthly discharge of South Fork of Big Timber Creek near Big Timber, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 7-31	125	6	53.6	2,660	B.
June	287	41	147	8,750	B.
July	340	106	185	11,400	B.
August	187	17	60.5	3,720	B.
September	21	2	9.6	571	C.
October	21	6	9.1	560	C.
November 1-9	6	6	6.0	107	C.
1908.					
March 22-31	4	2	2.6	52	C.
April	33	4	12.1	720	B.
May	119	3	29.0	1,780	A.
June	550	28	332	19,800	B.
July	294	33	144	8,850	A.
August	33	3	17.5	1,080	A.
September	15	8	11.1	660	B.
October 1-24	15	10	12.6	600	B.
The period	.....	.....	.....	33,500	

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EAST FORK OF BOULDER RIVER NEAR M'LEOD, MONT.

This station, which was established August 13, 1907, to determine the value of the stream for power and irrigation, is located at the first highway bridge over the East Boulder, 4 miles from McLeod. The station is 1 mile above the mouth.

This fork, which drains a valley of well-irrigated land, has no important tributaries. Several ditches receive their water from the East Boulder.

The bed of the stream is composed of coarse gravel and bowlders and should be permanent, but the swiftness of the current at high stages and the rough rocky bed make it difficult to obtain good results. This stream freezes over during the winter months. No change in gage datum has been made.

Discharge measurements of East Fork of Boulder River near McLeod, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 13 a	J. E. Stewart	35	30.5	0.50	89
September 28 a	do	34	25.6	.33	41.8
1908.					
May 11 a	Raymond Richards	26.5	34.8	.49	86.5
June 9	do	52.5	72.1	1.10	379
July 25 a	do	35	40.3	.55	121
October 9 a	J. E. Stewart	34	23.4	.22	40.2

a Made by wading.

Daily gage height, in feet, of East Fork of Boulder River near McLeod, Mont., for 1907 and 1908.

[E. C. McConnell, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1		0.38	0.35	0.28	0.20	16	0.42	0.30	0.30	0.20	
2		.35	.35	.25	.20	17	.40	.30	.25	.20	
3		.35	.35	.25	.15	18	.40	.30	.25	.20	
4		.35	.35	.25	.15	19	.42	.30	.25	.20	
5		.32	.32	.25	.15	20	.40	.30	.25	.20	
6		.32	.30	.25	.15	21	.40	.30	.25	.20	
7		.35	.30	.25	.15	22	.40	.30	.25	.20	
8		.30	.30	.25	.15	23	.38	.30	.25	.20	
9		.30	.30	.25	.15	24	.35	.30	.25	.20	
10		.30	.30	.20	.15	25	.32	.30	.25	.20	
11		.32	.30	.20	.15	26	.35	.30	.25	.20	
12		.33	.30	.20	.15	27	.35	.35	.25	.20	
13	0.5	.35	.30	.20	.15	28	.38	.35	.25	.20	
14	.48	.35	.30	.20	.15	29	.35	.35	.25	.20	
15	.45	.32	.30	.20	.15	30	.38	.35	.25	.15	
						31	.38		.30		

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Daily gage height, in feet, of East Fork of Boulder River near McLeod, Mont., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
1	0.12	0.05	0.15	1.25	1.8	0.40	0.20	0.20	0.20
2	.10	.08	.20	1.15	1.6	.38	.20	.18	.20
3	.12	.08	.20	1.15	1.7	.32	.20	.20	.20
4	.12	.05	.30	1.05	1.35	.30	.20	.20	.20
5	.12	.05	.28	.95	1.15	.30	.20	.20	.20
6	.10	.05	.45	.85	1.05	.30	.20	.20	.20
7	.10	.05	.68	.85	1.05	.30	.18	.20	.20
8	.10	.05	.70	.90	1.15	.25	.18	.20	.20
9	.10	.05	.65	1.05	1.10	.25	.15	.20	.20
10	.10	.05	.55	1.10	1.00	.20	.15	.20	.18
11	.12	.05	.48	1.20	.95	.20	.15	.20	.18
12	.10	.05	.45	1.60	.95	.22	.15	.20	.20
13	.08	.05	.40	1.65	.90	.22	.15	.20	.20
14	.10	.05	.38	1.70	.90	.28	.15	.20	.15
15	.10	.05	.35	1.80	.85	.25	.15	.28	.15
16	.10	.05	.45	1.65	.80	.25	.15	.25	.15
17	.10	.05	.45	1.45	.72	.25	.15	.25	.15
18	.12	.10	.40	1.30	.68	.25	.15	.20	.15
19	.10	.12	.42	1.10	.68	.25	.15	.20	.15
20	.10	.28	.50	1.05	.65	.25	.15	.20	.15
21	.08	.45	.45	1.00	.60	.25	.15	.18	.15
22	.10	.50	.50	.90	.58	.25	.15	.20	.15
23	.05	.50	.52	.82	.60	.25	.15	.20	.15
24	.10	.35	.55	.95	.62	.25	.15	.20	.15
25	.10	.30	.58	1.45	.55	.25	.15	.20	.15
26	.10	.25	.70	1.85	.55	.25	.10	.20	.10
27	.10	.20	.75	1.50	.55	.22	.15	.20	.12
28	.08	.20	.85	1.05	.52	.20	.15	.20	.10
29	.08	.15	.80	1.15	.52	.20	.18	.20	.12
30	.08	.18	.85	1.35	.50	.20	.18	.20	.10
31	.05	.....	1.10	.....	.45	.20	.....	.20	.....

NOTE.—Ice conditions December 16–31, 1907.

Rating tables for East Fork of Boulder River near McLeod, Mont.

AUGUST 13, 1907, TO JUNE 26, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	3	0.50	89	1.00	315	1.50	645
.10	10	.60	122	1.10	375	1.60	720
.20	21	.70	160	1.20	440	1.70	795
.30	36	.80	205	1.30	505	1.80	870
.40	60	.90	257	1.40	575		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is fairly well defined below gage height 1.2 feet.

JUNE 27 TO NOVEMBER 30, 1908.

0.00	11	0.50	104	1.00	330	1.50	650
.10	23	.60	139	1.10	390	1.60	720
.20	38	.70	180	1.20	450	1.70	790
.30	56	.80	225	1.30	510	1.80	860
.40	77	.90	275	1.40	580		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during this period and on the form of the previous curve. It is fairly well defined.

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Monthly discharge of East Fork of Boulder River near McLeod, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre feet).	Accuracy
	Maximum.	Minimum.	Mean.		
1907.					
August 13–31	89	41	59.5	2,240	B.
September	55	36	41.9	2,490	B.
October	48	28	34.1	2,100	B.
November	33	16	23.1	1,370	C.
December 1–15	21	16	16.7	497	C.
1908.					
March	12	6	9.97	613	D.
April	89	6	20.1	1,200	C.
May	375	16	107	6,580	B.
June	908	215	470	28,000	B.
July	860	90	286	17,600	A.
August	77	38	47.7	2,930	A.
September	38	23	32.0	1,900	B.
October	51	35	38.7	2,380	B.
November	38	23	32.3	1,920	B.
The period				63,100	

WEST FORK OF BOULDER RIVER NEAR BRUFFEYS, MONT.

This station, which is located at the highway bridge on the Livingston road about 7 miles from Bruffeys and 30 miles from Big Timber, was established May 7, 1904, by the state engineer of Montana, for the purpose of obtaining data in connection with irrigation projects. On May 4, 1907, it was transferred to the United States Geological Survey.

West Fork receives numerous small tributaries which enter from both sides above the station, the largest being Davis Creek, which comes in from the west 1½ miles upstream. One small irrigation ditch above the station diverts 3 or 4 second-feet of water. The drainage area is 94 square miles.

The channel is composed of small bowlders and coarse gravel and is reasonably permanent. The gage datum has remained unchanged since the station was established and the results obtained are excellent for the entire open season. At times during the winter this stream is open, but during the greater part of this period the gage heights are affected by ice.

The gage heights from 1904 to May 2, 1907 were furnished by J. W. Wade, state engineer of Montana.

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Discharge measurements of West Fork of Boulder River near Bruffeys, Mont., in 1904, 1907, and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	J. S. Baker			2.00	258
May 18	do			2.18	318
November 17	do			1.18	36
1907.					
May 3 [a]	Robert Follansbee	63	57	1.38	64
May 28	do	75	110	1.93	212
June 10	do	78	173	2.60	618
July 2	Follansbee and Stewart	78	227	3.42	1,180
September 28 [a]	J. E. Stewart	60	70	1.53	96
1908.					
October 8 [a]	J. E. Stewart	57	57.2	1.38	65.6

[a] Made by wading.

Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1904–1908.

[George Knight, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.[a]												
1						3.18	3.60	2.10	1.55	1.40	1.40	1.30
2						2.98	3.38	2.10	1.70	1.40	1.40	1.30
3						2.78	3.45	2.08	1.70	1.40	1.35	1.35
4						2.58	3.40	2.02	1.70	1.45	1.30	1.45
5						2.52	3.30	2.05	1.65	1.50	1.30	1.50
6						2.78	3.18	2.00	1.65	1.40	1.30	1.50
7						3.08	3.05	2.00	1.60	1.40	1.30	1.50
8						2.82	3.08	2.05	1.60	1.45	1.30	1.50
9						3.15	3.02	1.92	1.60	1.45	1.20	1.50
10						3.38	2.95	1.95	1.70	1.40	1.20	1.50
11						3.25	3.05	2.32	1.70	1.40	1.20	1.50
12						3.02	2.95	2.15	1.70	1.40	1.20	1.50
13						3.18	2.80	2.00	1.60	1.40	1.25	1.50
14						3.32	3.02	1.95	1.60	1.40	1.20	1.60
15						3.45	2.82	1.98	1.70	1.40	1.20	1.60
16						3.60	2.75	1.88	1.60	1.40	1.20	1.60
17					2.00	3.82	2.55	1.85	1.60	1.40	1.20	1.60
18					2.19	3.92	2.48	1.88	1.60	1.40	1.20	1.60
19					2.50	3.70	2.48	1.82	1.60	1.40	1.20	1.60
20					2.90	3.60	2.48	1.75	1.50	1.40	1.20	1.60
21					2.90	3.68	2.62	1.70	1.50	1.40	1.20	1.70
22					3.15	3.60	2.60	1.65	1.45	1.50	1.20	1.70
23					3.20	3.52	2.68	1.70	1.40	1.40	1.20	1.80
24					3.15	3.10	2.65	1.70	1.45	1.40	1.20	1.75
25					2.70	2.65	2.55	1.70	1.45	1.40	1.20	1.35
26					2.50	2.60	2.42	1.65	1.40	1.45	1.25	1.45
27					2.40	2.70	2.35	1.55	1.45	1.45	1.25	1.60
28					2.50	2.90	2.45	1.70	1.50	1.40	1.20	1.50
29					2.60	3.22	2.45	1.70	1.50	1.40	1.20	1.55
30					2.90	3.52	2.30	1.70	1.45	1.40	1.20	1.50
31					3.10	.....	2.08	1.65	.....	1.40	.....	1.55
1905.[b]												
1	1.45	.....	1.1	.....	.....	.....	2.95	1.9	1.5	1.4	1.3	1.2
2	1.5	.....	1.1	.....	.....	.....	2.95	1.85	1.5	1.4	1.25	1.2
3	1.45	.....	1.1	.....	.....	.....	2.95	1.9	1.4	1.4	1.2	1.2
4	1.5	.....	1.1	.....	.....	3.15	2.85	1.75	1.45	1.3	1.2	1.2
5	1.45	.....	1.1	.....	.....	3.45	2.85	1.7	1.45	1.3	1.2	1.2
6	1.55		1.15	.....	.....	3.15	2.9	1.65	1.4	1.3	1.2	1.25
7	1.6	.....	1.15	.....	.....	3.15	2.9	1.55	1.4	1.4	1.2	1.2
8	1.5	.....	1.1	.....	.....	3.45	2.75	1.45	1.3	1.4	1.2	1.2
9	1.45	.....	1.2	.....	.....	3.4	2.75	1.25	1.3	1.4	1.2	1.2
10	1.5	.....	1.15	.....	.....	3.9	2.8	1.05	1.3	1.4	1.2	1.2

[a] Probable ice conditions during December, 1904.
[b] Probable ice conditions January, February, and December, 1905. Ice jams December 22 and 25, 1905.

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Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1904–1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.[a]												
11	1.35	.....	1.1	.....	.....	.....	2.85	1.05	1.3	1.45	1.2	1.2
12	1.35	.....	1.15	.....	.....	.....	2.75	1.1	1.3	1.4	1.2	1.2
13	.....	.....	1.1	.....	.....	.....	2.65	1.05	1.3	1.4	1.2	1.2
14	.....	.....	1.15	.....	.....	.....	2.65	1.05	1.2	1.4	1.2	1.2
15	.....	.....	1.1	.....	.....	.....	2.6	1.0	1.2	1.4	1.2	1.2
16	.....	.....	1.1	.....	.....	.....	2.55	1.0	1.2	1.4	1.2	1.2
17	.....	.....	1.1	.....	.....	.....	2.35	1.40	1.2	1.3	1.2	1.2
18	.....	.....	1.1	.....	.....	2.4	2.35	1.45	1.2	1.3	1.2	1.2
19	.....	.....	1.1	.....	.....	2.5	2.3	1.35	1.2	1.3	1.2	1.2
20	.....	.....	1.15	.....	.....	2.4	2.3	1.5	1.2	1.3	1.2	1.2
21	.....	.....	1.1	.....	.....	2.5	2.3	1.5	1.2	1.35	1.2	1.2
22	1.2	.....	1.1	.....	.....	3.0	2.25	1.5	1.2	1.35	1.2	1.45
23	1.2	.....	1.1	.....	.....	2.8	2.1	1.45	1.2	1.3	1.2	1.25
24	1.2	.....	1.1	.....	.....	2.8	2.05	1.5	1.2	1.3	1.2	1.2
25	1.1	1.1	1.15	.....	.....	2.85	2.05	1.5	1.35	1.3	1.2	1.45
26	1.1	1.1	1.1	.....	.....	2.65	2.0	1.5	1.4	1.3	1.2	1.45
27	1.2	1.1	1.1	.....	.....	3.3	2.0	1.5	1.4	1.2	1.2	1.3
28	1.1	1.15	1.1	.....	.....	3.15	2.05	1.5	1.35	1.2	1.2	1.3
29	1.1	.....	1.1	.....	.....	3.15	2.1	1.5	1.4	1.2	1.2	1.45
30	1.35	.....	1.1	.....	.....	2.95	1.95	1.5	1.4	1.2	1.2	1.45
31	.....	.....	1.1	.....	.....	.....	1.95	1.5	.....	1.3	.....	1.5
1906.[b]												
1	1.5	1.1	1.35	1.1	1.85	2.1	3.05	.....	.....	.....	1.3	1.5
2	1.5	1.1	1.35	1.1	1.65	2.15	2.75	.....	.....	.....	1.3	1.4
3	1.6	1.1	1.25	1.1	1.85	2.55	2.65	.....	.....	.....	1.3	1.4
4	1.6	1.1	1.2	1.1	1.65	2.55	2.75	.....	.....	.....	1.4	1.3
5	1.65	1.1	1.25	1.1	1.75	2.65	2.75	.....	.....	.....	1.35	1.3
6	1.7	1.1	1.3	1.15	1.85	2.65	2.65	.....	.....	.....	1.3	1.3
7	1.7	1.2	1.3	1.3	1.85	2.75	2.55	.....	.....	.....	1.3	1.3
8	1.65	1.2	1.3	1.25	1.85	2.75	2.65	.....	.....	.....	1.3	1.3
9	1.6	1.3	1.3	1.2	1.85	2.85	2.65	.....	.....	.....	1.3	1.3
10	1.5	1.3	1.2	1.25	2.55	3.05	2.65	.....	.....	.....	1.4	1.3
11	1.5	1.2	.....	1.3	2.25	3.1	2.65	.....	.....	.....	1.3	1.3
12	1.55	1.2	.....	1.2	2.25	3.55	2.65	.....	.....	.....	1.3	1.3
13	1.55	1.2	.....	1.3	2.4	3.45	3.0	.....	.....	.....	1.3	1.3
14	1.5	1.2	.....	1.35	2.55	3.45	.....	.....	.....	1.3	1.3	1.3
15	1.5	1.25	.....	1.3	2.45	3.55	.....	.....	.....	1.3	1.3	1.3
16	1.5	1.3	.....	1.45	2.55	3.45	.....	.....	.....	1.4	1.3	1.3
17	1.55	1.3	.....	1.35	2.55	3.45	.....	.....	.....	1.4	1.3	1.25
18	1.5	1.3	.....	1.35	2.5	3.35	.....	.....	.....	1.4	1.3	1.3
19	1.45	1.3	.....	1.45	2.15	3.25	.....	.....	.....	1.4	1.3	1.3
20	1.5	1.3	.....	1.55	2.2	3.05	.....	.....	.....	1.4	1.3	1.2
21	1.5	1.25	.....	1.55	2.25	3.15	.....	.....	.....	1.4	1.3	1.2
22	1.4	1.2	.....	1.65	2.35	3.15	.....	.....	.....	1.4	1.3	1.2
23	1.45	1.25	.....	1.85	2.4	3.05	.....	.....	.....	1.4	1.45	1.15
24	1.45	1.3	.....	1.95	2.45	3.1	.....	.....	.....	1.4	1.3	1.1
25	1.45	1.4	.....	1.9	2.4	3.05	.....	.....	.....	1.4	1.3	1.1
26	1.5	1.4	1.1	1.75	2.45	2.65	.....	.....	.....	1.4	1.3	1.1
27	1.5	1.35	1.1	1.75	2.4	2.45	.....	.....	.....	1.45	1.4	1.1
28	1.5	1.35	1.1	1.65	2.3	2.65	.....	.....	.....	1.4	1.3	1.1
29	1.25	.....	1.1	1.5	2.15	2.75	.....	.....	.....	1.3	1.3	1.1
30	1.2	.....	1.1	1.75	2.15	2.75	.....	.....	.....	1.3	1.4	1.1
31	1.1	.....	1.1	.....	2.1	.....	.....	.....	.....	1.3	.....	.....
1907.[c]												
1	.....	.....	1.30	1.20	1.40	2.45	3.34	2.48	1.65	1.52	.....	1.50
2	.....	.....	1.30	1.30	1.38	2.48	3.58	2.50	1.65	1.55	.....	1.40
3	.....	.....	1.20	1.30	1.38	2.52	3.64	2.48	1.68	1.58	1.20	1.40
4	.....	.....	1.20	1.30	1.40	2.60	3.90	2.42	1.68	1.55	1.20	1.35
5	.....	.....	1.20	1.30	1.40	2.80	3.68	2.45	1.65	1.55	1.30	1.30
6	.....	.....	1.20	1.30	1.45	3.00	3.70	2.48	1.68	1.45	1.30	1.30
7	.....	.....	1.20	1.20	1.45	3.10	3.40	2.32	1.68	1.42	1.20	1.30
8	.....	.....	1.20	1.30	1.50	3.15	3.25	2.30	1.65	1.42	1.20	1.30
9	.....	.....	1.20	1.30	1.50	3.00	3.24	2.25	1.65	1.40	1.20	1.30
10	.....	.....	1.10	1.30	1.55	3.30	3.21	2.28	1.65	1.40	1.20	1.30

[a] ...conditions January, February, and December, 1905. Ice jams December 22 and 25, 1905.
[b] ...conditions January, February, and to about March 25, and December, 1906. Ice jam ...06.
[c] ...ditions January, February, and December, 1907.

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Daily gage height, in feet, of West Fork of Boulder River near Bruffeys, Mont., for 1904–1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]												
11	.....	.....	1.10	1.30	1.55	3.10	3.26	2.18	1.62	1.42	1.20	1.30
12	.....	1.10	1.10	1.30	1.55	3.10	3.19	2.15	1.65	1.42	1.20	1.30
13	.....	1.10	1.20	1.30	1.90	3.15	3.21	2.12	1.62	1.40	1.20	1.30
14	.....	1.10	1.20	1.30	1.80	3.00	3.50	2.15	1.60	1.40	1.20	1.30
15	.....	1.10	1.30	1.30	1.90	3.18	3.11	2.10	1.58	1.42	1.20	1.30
16	.....	1.20	1.20	1.30	2.00	3.00	2.92	2.00	1.55	1.42	1.20	1.30
17	.....	1.20	1.20	1.30	2.20	2.45	2.78	1.80	1.52	1.40	1.20	1.30
18	.....	1.10	1.30	1.30	2.50	2.62	2.72	1.80	1.50	1.42	1.20	1.30
19	.....	1.10	1.30	1.30	2.50	3.12	2.70	1.72	1.48	1.40	1.20	1.20
20	.....	1.10	1.30	1.40	2.45	3.40	2.80	1.68	1.45	1.40	1.20	1.20
21	.....	1.10	1.30	1.50	2.50	3.52	2.78	1.52	1.50	1.38	1.20	1.20
22	.....	1.10	1.20	1.40	2.45	3.55	2.99	1.38	1.45	1.35	1.20	1.20
23	.....	1.10	1.20	1.40	2.40	3.00	2.89	1.22	1.40	1.35	1.20	1.15
24	.....	1.10	1.20	1.40	2.40	2.89	2.78	1.18	1.45	1.32	1.20	1.10
25	.....	1.10	1.20	1.40	2.32	2.68	2.71	1.52	1.40	1.30	1.20	1.10
26	.....	1.10	1.20	1.40	2.20	2.61	2.52	1.62	1.48	1.32	1.20	1.10
27	.....	1.10	1.20	1.40	2.00	2.84	2.48	1.68	1.48	1.35	1.18	1.10
28	.....	1.10	1.20	1.40	1.98	3.01	2.48	1.68	1.42	1.35	1.18	1.10
29	.....	.....	1.20	1.40	2.00	3.35	2.50	1.68	1.45	1.35	1.18	1.10
30	.....	.....	1.20	1.50	2.00	3.40	2.45	1.68	1.55	1.32	1.18	1.10
31	.....	.....	1.20	.....	2.30	.....	2.48	1.68	.....	1.35	.....	.....
1908.[b]												
1	.....	.....	.....	1.08	1.52	2.70	3.00	2.38	1.30	1.20	1.20	1.30
2	.....	.....	.....	1.20	1.50	2.52	2.80	2.22	1.30	1.10	1.30	1.30
3	.....	.....	.....	1.08	1.50	2.50	2.60	2.10	1.20	1.20	1.10	1.20
4	.....	.....	.....	1.15	1.52	2.52	2.60	2.10	1.30	1.00	1.20	1.20
5	.....	.....	.....	1.15	1.58	2.58	2.60	2.00	1.40	1.10	1.30	1.30
6	.....	.....	.....	1.15	1.60	2.55	2.40	2.10	1.50	1.20	1.10	1.20
7	.....	.....	1.20	1.08	1.68	2.50	2.50	1.98	1.40	1.30	1.30	1.30
8	.....	.....	1.25	1.08	1.65	2.52	2.60	1.92	1.40	1.38	1.20	1.20
9	.....	.....	1.20	1.20	1.70	2.62	2.80	1.80	1.50	1.30	1.20	1.30
10	.....	.....	1.20	1.08	1.72	2.80	3.00	1.72	1.30	1.20	1.30	1.20
11	.....	.....	1.22	1.35	1.75	2.90	3.60	1.80	1.20	1.10	1.30	1.20
12	.....	.....	1.25	1.40	1.75	3.60	3.80	1.70	1.10	1.20	1.20	1.30
13	.....	.....	1.20	1.50	1.78	3.62	3.70	1.60	1.20	1.20	1.10	1.30
14	.....	.....	1.20	1.52	1.78	3.82	3.50	1.52	1.10	1.10	1.20	1.20
15	.....	.....	1.25	1.55	1.78	3.80	3.40	1.50	1.10	1.20	1.30	1.30
16	.....	.....	1.20	1.55	1.80	3.78	3.20	1.40	1.20	1.10	1.20	1.30
17	.....	.....	1.25	1.58	1.80	3.50	3.10	1.30	1.10	1.10	1.30	1.20
18	.....	.....	1.22	1.62	1.80	3.20	3.10	1.40	1.20	1.00	1.20	1.30
19	.....	.....	1.25	1.70	1.80	2.80	2.90	1.30	1.30	1.10	1.20	1.20
20	.....	.....	1.20	1.72	1.85	2.90	2.80	1.20	1.40	1.20	1.30	.....
21	.....	.....	1.22	1.72	2.00	2.60	2.70	1.10	1.50	1.10	1.30	.....
22	.....	.....	1.20	1.80	2.10	2.48	2.40	1.20	1.40	1.20	1.20	.....
23	.....	.....	1.20	1.50	2.22	2.40	2.50	1.10	1.40	1.10	1.30	.....
24	.....	.....	1.08	1.50	1.80	2.52	2.40	1.20	1.30	1.20	1.30	.....
25	.....	.....	1.20	1.40	1.75	3.10	2.40	1.32	1.20	1.10	1.20	.....
26	.....	.....	1.08	1.40	1.90	3.30	2.50	1.30	1.30	1.20	1.20	.....
27	.....	.....	1.22	1.42	1.85	2.90	2.40	1.40	1.30	1.10	1.30	.....
28	.....	.....	1.20	1.48	2.20	3.00	2.30	1.50	1.40	1.20	1.30	.....
29	.....	.....	1.20	1.50	2.22	3.02	2.33	1.40	1.30	1.30	1.20	.....
30	.....	.....	1.20	1.50	2.10	3.30	2.40	1.30	1.20	1.10	1.20	.....
31	.....	.....	1.20	.....	2.82	.....	2.30	1.20	.....	1.20	.....	.....

[a] Probable ice conditions January, February, and December, 1907.
[b] Probable ice conditions January 1–March 7, and after December 18, 1908.

31260—IRR 246—10——11

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Rating table for West Fork of Boulder River near Bruffeys, Mont., for May 17, 1904, to December 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	20	1.80	171	2.60	590	3.40	1,190
1.10	27	1.90	208	2.70	660	3.50	1,270
1.20	37	2.00	250	2.80	730	3.60	1,350
1.30	50	2.10	295	2.90	805	3.70	1,430
1.40	66	2.20	345	3.00	880	3.80	1,510
1.50	86	2.30	400	3.10	955	3.90	1,590
1.60	110	2.40	460	3.20	1,030		
1.70	138	2.50	525	3.30	1,110		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on nine discharge measurements made during 1904, 1907, and 1908, and is well defined between gage heights 1.10 feet and 3.5 feet.

Monthly discharge of West Fork of Boulder River near Bruffeys, Mont., for 1904 to 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1904.					
May 17–31	1,030	250	684	20,400	A.
June	1,610	538	1,030	61,300	A.
July	1,350	286	748	46,000	A.
August	412	98	208	12,800	A.
September	138	66	105	6,250	A.
October	86	66	68.9	4,240	B.
November	66	37	42.5	2,530	C.
The period				154,000	
1905.					
March	37	27	28.5	1,750	D.
June, 20 days	1,590	460	893	35,400	A.
July	842	229	531	32,600	A.
August	208	20	84.7	5,210	A.
September	86	37	53.6	3,190	B.
October	76	37	55.9	3,440	B.
November	50	37	37.7	2,240	C.
The period				83,800	
1906.					
March	58	20	30.3	1,860	D.
April	229	27	82.5	4,910	B.
May	558	124	360	22,100	A.
June	1,310	295	853	50,800	A.
July 1–13	918	558	678	17,500	A.
October 14–31	76	50	62.1	2,220	B.
November	76	50	53.3	3,170	C.
1907.					
March	50	27	39.0	2,400	D.
April	86	37	56.3	3,350	C.
May	525	60	250	15,400	A.
June	1,310	492	868	51,600	A.
July	1,590	492	918	56,400	A.
August	525	35	263	16,200	A.
September	132	66	102	6,070	A.
October	105	50	69.0	4,240	A.
November	50	35	38.3	2,280	C.
The period				158,000	
1908.					
March 7–31	44	26	38.0	1,880	C.
April	171	26	74.8	4,450	A.
May	745	86	198	12,200	A.
June	1,530	460	851	50,600	A.
July	1,510	400	743	45,700	A.
August	448	27	133	8,180	A.
September	86	27	51.2	3,050	B.
October	63	20	34.1	2,100	B.
November	50	27	41.6	2,480	C.
December 1–19	50	37	43.8	1,650	C.
The period				132,000	

NOTE.—Discharge estimated March 11–25, 1906; November 1–2, 1907.

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WEST FORK OF BOULDER RIVER AT M'LEOD, MONT.

This station was established May 4, 1907, at Koozer's private bridge, several hundred yards upstream from the highway bridge at McLeod post-office, to determine the value of the stream for irrigation and power.

The West Fork has no important tributaries, deriving the greater part of its water from melting snow. It joins the main Boulder about 1 mile below the gaging station. The drainage area above the station is 137 square miles.

Water to irrigate about 800 acres of land is diverted above this station. A Carey Land Act project reclaiming 12,000 to 15,000 acres is now under investigation, the water to be diverted from the West Fork about 12 miles above the station.

The gage datum has remained unchanged. The bed of the stream is composed of bowlders, and is rough, but permanent. Ice forms during the winter months, but results obtained are good during the open season.

Discharge measurements of West Fork of Boulder River at McLeod, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 3	Robert Follansbee	42	55	a 0.55	82
May 29	do	57	106	1.38	277
June 11	do	57	138	2.02	623
July 3	Follansbee and Stewart	57	219	3.12	1,480
August 13	J. E. Stewart	54	89	1.20	228
September 27 b	do	43	60	.70	92
1908.					
May 11	Raymond Richards	60	108	1.25	276
June 9	do	54.5	145	2.15	637
July 25	do	55.5	124	1.69	457
October 9 b	J. E. Stewart	47	61.7	.62	72.1

a Gage height uncertain. b Made by wading.

Daily gage height, in feet, of West Fork of Boulder River at McLeod, Mont., for 1907 and 1908.

[H. J. Koozer, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1						1.85	2.58	1.78	0.88	0.72	0.48	0.40
2						2.30	2.85	1.72	.88	.72	.48	.40
3						1.90	3.00	1.68	.85	.72	.45	.40
4					0.55	1.75	3.35	1.65	.85	.70	.45	.40
5					.55	2.12	2.78	1.60	.88	.68	.45	.40
6					.58	2.45	2.65	1.58	.90	.68	.45	.40
7					.60	2.35	2.62	1.55	1.05	.62	.45	.40
8					.62	2.40	2.65	1.48	.95	.62	.45	.40
9					.72	2.62	2.58	1.52	.85	.58	.45	.45
10					.90	2.12	2.58	1.45	.85	.58	.45	.48
11					1.22	2.05	2.60	1.42	.85	.58	.45	.48
12					1.35	2.52	2.48	1.38	.82	.55	.45	.42
13					1.10	2.32	2.48	1.25	.78	.52	.45	.40
14					1.08	2.15	2.42	1.22	.72	.52	.45	.40
15					1.02	2.08	2.52	1.18	.70	.52	.45	.40

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Daily gage height, in feet, of West Fork of Boulder River at McLeod, Mont., for 1907 and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
16					1.25	1.90	2.45	1.15	0.70	0.52	0.45	0.40
17					1.45	1.75	2.10	1.15	.68	.52	.45	
18					1.70	2.00	2.22	1.20	.68	.52	.45	
19					1.68	2.42	2.18	1.12	.68	.52	.45	.80
20					2.15	2.62	2.15	1.08	.68	.52	.42	
21					1.88	2.68	2.32	1.08	.62	.52	.40	
22					1.70	2.55	2.28	1.00	.62	.52	.40	
23					1.68	2.70	2.28	.90	.58	.50	.40	
24					1.48	2.20	2.20	.92	.58	.50	.40	.30
25					1.40	2.00	2.38	.92	.58	.50	.40	
26					1.28	1.95	2.10	.98	.65	.50	.40	
27					1.30	2.30	1.95	.98	.70	.48	.40	.40
28					1.28	2.70	1.85	.92	.72	.48	.40	
29					1.32	2.75	1.78	.90	.70	.50	.40	
30					1.42	2.78	1.95	.88	.72	.50	.40	
31					1.42		1.82	.88		.50		
1908.												
1				0.35	.80	2.15	2.50	1.35	.62	.52		
2				.35	.85	2.75	2.95	1.32	.62	.55		
3	1.90			.38	.98	2.60	2.88	1.28	.62	.55		
4				.30	.92	2.45	3.25	1.25	.60	.60		
5				.30	.92	2.20	2.90	1.20	.60	.60		
6			0.80	.28	1.28	2.00	2.45	1.15	.60	.60		
7		2.00		.30	1.45	2.02	2.35	1.10	.60	.60		
8				.30	1.75	2.12	2.45	1.08	.58	.60		
9				.30	1.55	2.20	2.60	1.12	.58	.60		
10	1.30			.38	1.45	2.22	2.70	1.10	.58	.60		
11				.38	1.30	2.32	2.65	1.08	.58	.65		
12				.45	1.25	2.90	2.70	1.08	.58	.65		
13			.45	.58	1.15	2.85	2.60	1.08	.58	.68		
14		.90		.68	1.08	2.75	2.50	1.08	.58	.72		
15				.70	1.10	3.05	2.40	1.02	.58	.75		
16				.72	1.12	2.90	2.35	1.02	.58	.75		
17	1.70			.80	1.12	2.55	2.25	1.05	.55	.70		
18				1.00	1.02	2.50	1.95	1.25	.55	.70		
19				1.20	1.00	2.40	1.88	.95	.55	.68		
20			.52	1.22	1.05	2.32	1.80	.90	.52	.65		
21		1.40	.42	1.30	1.08	2.18	1.88	.85	.52	.62		
22			.40	1.30	1.18	1.85	1.80	.82	.52	.60		
23	.80		.45	1.25	1.20	1.80	1.75	.82	.52	.60		
24			.40	1.12	1.22	1.85	1.70	.80	.50	.60		
25			.38	1.05	1.30	1.92	1.65	.78	.50	.60		
26			.38	.92	1.50	2.25	1.65	.78	.50	.62		
27			.40	.80	1.60	2.95	1.75	.72	.50	.60		
28		.50	.35	.80	1.72	2.30	1.65	.72	.50	.60		
29			.35	.75	1.78	2.20	1.55	.72	.50	.60		
30			.30	.75	1.85	2.38	1.52	.68	.50	.60		
31	2.20		.30		2.08		1.48	.68		.60		

NOTE.—Ice conditions during the last half of December, 1907, and January to March 19, 1908.

Rating tables for West Fork of Boulder River at McLeod, Mont.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	61	1.20	218	2.00	615	2.80	1,210
.50	68	1.30	254	2.10	680	2.90	1,295
.60	78	1.40	294	2.20	750	3.00	1,380
.70	92	1.50	338	2.30	820	3.10	1,465
.80	110	1.60	385	2.40	895	3.20	1,550
.90	132	1.70	435	2.50	970	3.30	1,640
1.00	158	1.80	490	2.60	1,050	3.40	1,730
1.10	186	1.90	550	2.70	1,130		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907 and is fairly well defined.

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Rating tables for West Fork of Boulder River at McLeod, Mont.—Continued.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	27	1.00	165	1.80	489	2.60	1,020
.30	34	1.10	195	1.90	543	2.70	1,102
.40	44	1.20	228	2.00	602	2.80	1,188
.50	57	1.30	264	2.10	664	2.90	1,278
.60	73	1.40	303	2.20	729	3.00	1,373
.70	92	1.50	345	2.30	797	3.10	1,473
.80	114	1.60	390	2.40	868	3.20	1,573
.90	138	1.70	438	2.50	942	3.30	1,673

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1907–1909, and is fairly well defined between gage heights 0.3 foot and 2.2 feet. Above gage height 2.2 feet it is based on one measurement at gage height 3.12 feet and is only approximate.

Monthly discharge of West Fork of Boulder River at McLeod, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 4–31	715	73	264	14,700	A.
June	1,190	462	815	48,500	B.
July	1,680	479	902	55,500	B.
August	479	128	249	15,300	A.
September	172	76	105	6,250	A.
October	96	67	75.2	4,620	A.
November	67	61	63.1	3,750	B.
December	67	.....	54.4	3,340	C.
The period	.....	.....	.....	152,000	
1908.					
March 20–31	60	34	43.2	1,030	B.
April	264	33	109	6,490	A.
May	652	114	271	16,700	A.
June	1,420	489	863	51,400	B.
July	1,620	337	776	47,700	A.
August	284	88	170	10,500	A.
September	77	57	66.2	3,940	A.
October	103	60	78.1	4,800	A.
The period	.....	.....	.....	143,000	

NOTE.—Discharge for December 17–31, 1907, estimated.

SWEETGRASS CREEK ABOVE MELVILLE, MONT.

Sweetgrass Creek rises in the Crazy Mountains and flows southeastward to the Yellowstone, which it joins a short distance below Big Timber. It has no important tributaries. The drainage area is about 47 square miles.

The gaging station, which was established May 5, 1907, to determine the amount of water available for irrigation, storage, and power, is located at C. M. Rein's ranch, 16 miles northwest of Melville and 35 miles from Big Timber, on the reservoir site of a project proposed under the Carey Land Act.

A few small ditches divert water above the station. The stream freezes over during the winter months.

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Rating tables for Sweetgrass Creek above Melville, Mont.—Continued.

AUGUST 1 TO DECEMBER 17, 1907.

[Daily discharge obtained by the indirect method for shifting channels.]

APRIL 1 TO JUNE 11, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	16	2.40	161	3.40	489	4.40	1,020
1.50	24	2.50	185	3.50	535	4.50	1,080
1.60	33	2.60	211	3.60	585	4.60	1,140
1.70	44	2.70	239	3.70	635	4.70	1,200
1.80	56	2.80	268	3.80	685	4.80	1,260
1.90	70	2.90	299	3.90	740	4.90	1,325
2.00	85	3.00	332	4.00	795	5.00	1,390
2.10	101	3.10	368	4.10	850	5.20	1,520
2.20	119	3.20	406	4.20	905		
2.30	139	3.30	446	4.30	960		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and one in the latter part of 1907, and is fairly well defined.

JUNE 12 TO AUGUST 31, 1908.

[Daily discharge obtained by the indirect method for shifting channels.]

OCTOBER 1 TO NOVEMBER 30, 1908.

1.60	22	1.70	40	1.80	60		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1908 and is not well defined. This table refers to the lower gage.

Daily discharge, in second-feet, of Sweetgrass Creek above Melville, Mont., for 1907 and 1908.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1	240	71	39	28	28	16	178	62	33	28	28
2	220	71	39	28	28	17	170	62	33	28	28
3	260	71	39	28	28	18	134	62	33	28	.....
4	225	71	39	28	28	19	128	53	33	28	.....
5	210	71	39	28	28	20	108	53	33	28	.....
6	203	71	39	28	28	21	103	53	33	28	.....
7	186	71	39	28	28	22	97	46	33	28	.....
8	128	71	39	28	28	23	92	46	33	28	.....
9	186	71	39	28	28	24	92	46	33	28	.....
10	350	62	39	28	28	25	92	46	33	28	.....
11	260	62	33	28	28	26	92	46	33	28	.....
12	220	62	33	28	28	27	92	46	28	28	.....
13	210	62	33	28	28	28	92	46	28	28	.....
14	203	62	33	28	28	29	86	46	28	28	.....
15	186	62	33	28	28	30	81	46	28	28	.....
						31	81	.....	28	.....	.....

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1908.				1908.				1908.			
1	.....	440	112	11	.....	452	84	21	225	172	66
2	.....	430	112	12	1,080	368	84	22	200	165	65
3	.....	675	112	13	635	355	84	23	180	165	64
4	.....	780	102	14	585	385	75	24	198	165	63
5	.....	485	102	15	822	304	75	25	525	153	62
6	.....	312	102	16	712	255	75	26	660	153	61
7	.....	312	102	17	535	212	75	27	525	153	60
8	.....	585	102	18	368	187	75	28	285	153	59
9	.....	590	93	19	332	172	67	29	218	142	58
10	.....	585	93	20	254	172	67	30	285	142	57
								31	.....	132	56

These discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of Sweetgrass Creek above Melville, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 5-31	438	36	136	7,280	A.
June	810	255	466	27,700	A.
July	885	266	477	29,300	A.
August	350	81	158	9,720	B.
September	71	46	59.0	3,510	B.
October	39	28	34.1	2,100	C.
November	28	28	28.0	1,670	C.
December 1-17	28	28	28.0	944	C.
The period				82,200	
1908.					
April	16	16	16.0	952	D.
May	665	16	122	7,500	A.
June	1,490	180	529	31,500	B.
July	780	132	315	19,400	B.
August	112	56	79.5	4,890	B.
September			44.0	2,620	C.
October	50	22	33.9	2,080	B.
November	56	40	47.4	2,820	C.
The period				71,800	

NOTE.—Daily discharge for period August 20 to September 30, 1908, interpolated; otherwise discharge estimated for days when gage was not read.

SWEETGRASS CREEK BELOW MELVILLE, MONT.

This station, which was established May 4, 1907, to determine the amount of water available for irrigation, is located at Adams ranch, 9 miles below Melville, 20 miles from Big Timber, and 2½ miles below the head-gate of the Glass-Lindsay Land Company's canal, a Carey Land Act project.

Many diversions are made on this stream, with a total appropriation of 550 second-feet of adjudicated rights. The Glass-Lindsay canal, partly completed, will carry 575 second-feet and irrigate 30,000 acres. This canal will divert water into two storage reservoirs, with capacities of 12,000 and 6,000 acre-feet, respectively, which will be filled from the spring run-off, the low-water flow being all appropriated.

The stream bed is composed of clean gravel and is nonshifting. Ice forms during the winter season. Records obtained are good.

Discharge measurements of Sweetgrass Creek below Melville, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 4	Robert Follansbee	41	34.6	0.84	59
May 29	....do	50	59	1.30	172
June 11	....do	60	82	1.51	283
June 30	Follansbee and Stewart	40	139	2.12	619
September 25	J. E. Stewart	30	44.8	.90	43
1908.					
May 12[a]	Raymond Richards	48	53	1.27	115
May 24[a]	J. E. Stewart	35	57.9	1.12	82.6
June 10	Raymond Richards	44.5	155	2.47	625
July 23[a]	....do	52	54	1.30	121
October 6[a]	J. E. Stewart	34	51.2	.99	60.9

[a] Made by wading.

NOTE.—The 1907 measurements were made at various sections.

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Daily gage height, in feet, of Sweetgrass Creek below Melville, Mont., for 1907 and 1908.

[E. P. Adams and A. E. Cummings, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.								
1			1.55	1.90	1.58	1.02	0.92	0.85
2			1.75	1.95	1.55	1.00	1.05	.85
3			1.70	2.00	1.52	1.00	1.05	.85
4		0.85	1.58	2.10	1.52	1.00	1.00	.85
5		.85	1.55	2.05	1.50	1.00	.90	.85
6		.85	1.72	1.85	1.45	1.00	.90	.85
7		.85	1.82	1.75	1.45	1.00	.98	.85
8		.85	1.82	1.85	1.40	1.00	1.00	.85
9		.85	1.72	1.88	1.35	1.00	1.00	.85
10		.82	1.58	1.82	1.55	1.00	.98	.85
11		.88	1.52	1.75	1.60	1.00	.95	.85
12		.95	1.78	1.78	1.52	1.08	.95	.85
13		.95	1.78	1.98	1.48	1.12	.95	.85
14		.88	1.62	1.85	1.40	1.10	.95	.85
15		.85	1.65	1.95	1.40	1.05	.95	.85
16		.80	1.52	1.85	1.35	1.00	.95	.85
17		.80	1.48	1.88	1.35	1.05	.95	.85
18		1.00	1.45	1.85	1.20	1.00	.95	.85
19		1.08	1.62	1.85	1.12	1.00	.90	.85
20		1.62	1.85	1.78	1.08	1.00	.90	.85
21		1.60	1.80	1.85	1.05	1.00	.90	.85
22		1.52	1.85	1.82	1.00	.98	.85	.85
23		1.50	2.88	1.80	1.00	.90	.85	.85
24		1.50	2.05	1.72	1.00	.90	.85	.....
25		1.40	1.90	1.68	1.00	.90	.85	.....
26		1.38	1.80	1.65	1.00	.90	.85	.....
27		1.32	1.92	1.55	1.05	.90	.85	.....
28		1.30	2.08	1.55	1.02	.90	.85	.....
29		1.30	2.15	1.55	1.02	1.00	.85	.....
30		1.38	2.10	1.70	1.00	.95	.85	.....
31		1.40	.....	1.62	1.00	.....	.85	.....
1908.								
1	0.60	.60	3.60	1.98	.82	.80	.80	1.05
2	.60	.60	3.10	1.92	.72	.75	.80	1.05
3	.60	.60	3.10	2.20	.70	.72	.88	1.05
4	.60	.60	3.10	2.25	.65	.70	.90	1.10
5	.60	.60	2.60	2.18	.65	.70	.92	1.08
6	.60	.60	2.35	1.88	.60	.65	1.00	1.05
7	.60	.60	2.30	1.78	.60	.62	1.00	1.05
8	.60	.60	2.40	1.82	.60	.60	.90	.....
9	.60	.95	2.40	1.96	.52	.62	.90	.....
10	.60	1.38	2.48	2.12	.50	.68	.90	.....
11	.60	1.20	2.55	2.00	.50	.65	.90	.....
12	.60	1.12	2.95	1.90	.60	.70	.90	.....
13	.62	1.15	2.20	1.85	.62	.70	.90	.....
14	.65	1.15	2.42	1.90	.75	.70	.90	.....
15	.65	1.20	2.62	1.82	.72	.70	.90	.....
16	.60	1.20	2.70	1.75	.75	.70	1.00	.....
17	.60	1.15	2.55	1.65	.70	.70	1.00	.....
18	.60	1.15	2.30	1.48	.68	.70	.....	.....
19	.60	1.10	1.95	1.42	.65	.70	.....	.....
20	.60	1.12	1.95	1.38	.65	.70	.....	.....
21	.60	1.42	1.80	1.32	.72	.70	.....	.....
22	.60	1.28	1.72	1.30	.80	.70	.....	.....
23	.60	1.20	1.65	1.30	.75	.70	.....	.....
24	.60	1.12	1.55	1.25	.72	.70	.....	.....
25	.55	1.15	1.95	1.22	.70	.78	1.05	.....
26	.55	1.20	2.28	1.22	.70	.80	1.05	.....
27	.55	1.20	2.45	1.12	.70	.80	1.05	.....
28	.60	1.22	2.32	1.05	.72	.80	1.10	.....
29	.60	1.22	2.25	.75	.80	.80	1.05	.....
30	.60	1.25	1.85	.90	.80	.80	1.05	.....
31		1.25	.....	.88	.80	.....	1.05	.....

Ice conditions during latter part of November and December, 1907, and November 8 to Decem-
8.

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Rating tables for Sweetgrass Creek below Melville, Mont.

MAY 4 TO JULY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	52	1.40	219	2.00	545	2.60	952
.90	68	1.50	265	2.10	607	2.70	989
1.00	88	1.60	315	2.20	670	2.80	1,067
1.10	113	1.70	368	2.30	734	2.90	1,133
1.20	143	1.80	424	2.40	798		
1.30	179	1.90	483	2.50	863		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on four discharge measurements made during this period, and is fairly well defined between gage heights 0.8 foot and 2.2 feet.

AUGUST 1 TO NOVEMBER 23, 1907.

[Daily discharge obtained by the indirect method for shifting channels.]

APRIL 1 TO NOVEMBER 7, 1908.

0.50	11	1.30	121	2.10	431	2.90	885
.60	16	1.40	148	2.20	482	3.00	943
.70	23	1.50	178	2.30	535	3.10	1,003
.80	33	1.60	212	2.40	590	3.20	1,070
.90	45	1.70	250	2.50	647	3.30	1,133
1.00	60	1.80	291	2.60	705	3.40	1,200
1.10	77	1.90	335	2.70	765	3.50	1,265
1.20	97	2.00	382	2.80	825	3.60	1,330

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on five discharge measurements made during 1908 and one measurement in 1907. It is well defined between gage heights 0.8 foot and 1.4 feet. Above gage height 1.4 feet the rating curve is based on one measurement at gage height 2.5 feet.

Daily discharge, in second-feet, of Sweetgrass Creek below Melville, Mont., for 1907.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	Aug.	Sept.	Oct.	Nov.
1	291	70	48	39	16	182	66	52	39
2	275	66	70	39	17	182	78	52	39
3	260	66	70	39	18	123	66	52	39
4	260	66	60	39	19	98	66	45	39
5	250	66	45	39	20	86	66	45	39
6	226	66	45	39	21	78	66	45	39
7	226	66	55	39	22	66	61	39	39
8	204	66	60	39	23	66	45	39	39
9	182	66	60	39	24	66	45	39	.....
10	275	66	55	39	25	66	45	39	.....
11	300	66	52	39	26	66	45	39	.....
12	260	86	52	39	27	78	45	39	.....
13	241	98	52	39	28	70	45	39	.....
14	204	92	52	39	29	70	66	39	.....
15	204	78	52	39	30	66	54	39	.....
					31	66	.....	39	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of Sweetgrass Creek below Melville, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May 4–31	326	52	140	7,780	A.
June	1,120	242	424	25,200	A.
July	607	290	434	26,700	A.
August	300	66	164	10,100	A.
September	98	45	64.8	3,960	B.
October	70	39	48.7	2,990	B.
November 1–23	39	39	39.0	1,780	C.
The period				78,400	
1908.					
April	20	14	16.1	958	C.
May	855	16	127	7,810	A.
June	1,330	205	600	35,700	A.
July	508	43	242	14,900	A.
August	35	11	22.7	1,400	C.
September	33	16	24.6	1,460	C.
October	77	33	56.0	3,440	C.
November 1–7	77	68	70.1	973	B.
The period				66,600	

NOTE.—Discharge interpolated October 18–24, 1908.

CLARK FORK AT FROMBERG, MONT.

Clark Fork enters Yellowstone River from the south about 15 miles southwest of Billings, Mont. The stream is bordered by irrigable land which is used for agriculture.

The gaging station, which was established June 3, 1905, to determine the amount of water available for irrigation, is located on the highway bridge one-half mile east of the Northern Pacific Railway station at Fromberg, Mont.

One small stream, Red Rock Creek, flows into the river between the gaging station and its mouth. The drainage area above the station is about 2,500 square miles.

As almost all the valley land is under irrigation many diversions are made, but owing to the abundance of water only a small portion of the flow is used.

The ice period ranges from December to the middle of March, but frequently during this period the river breaks up and floating ice may be seen.

The original staff gage has been replaced by a standard chain gage, but no change in gage datum has occurred. Records obtained are excellent. The gaging section would be ideal if it were not for the middle pier of the bridge which divides the channel. The bed of the stream is composed of rock and gravel, is free from vegetation, and is permanent.

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Discharge measurements of Clark Fork at Fromberg, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 10	J. E. Stewart	120	288	3.56	374
June 1 [a]	do	207	733	6.04	3,320
July 12	do	214	1,130	7.83	6,590
August 17	do	184	526	4.95	1,410
November 12 [b]	do	125	310	3.64	370
1908.					
March 30	J. E. Stewart	118	263	3.40	269
May 22	do	158	438	4.54	1,080
June 13	Raymond Richards	211	1,090	7.55	5,850
July 20	do	206	750	6.10	3,030
October 10	J. E. Stewart	143	375	4.18	717

[a] Measurement made without sufficient amount of lead. [b] Slight ice conditions.

Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1907 and 1908.

[Mrs. E. V. Moran, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	3.5	5.1	3.55	3.5	4.0	6.1	7.85	6.45	4.8	4.4	3.65	3.6
2	3.5	5.1	3.5	3.58	4.4	7.0	8.95	6.35	4.8	4.5	3.65	3.6
3	3.6	5.1	3.5	3.65	4.5	6.85	8.5	6.2	4.65	4.2	3.65	3.6
4	3.8	5.1	3.5	3.65	4.55	6.25	9.0	6.2	4.6	4.0	3.65	3.55
5	3.8	5.1	3.5	3.65	3.9	6.5	9.15	6.2	4.5	4.0	3.65	3.55
6	3.8	5.1	3.45	3.65	3.8	6.95	8.55	6.05	4.5	4.0	3.6	3.55
7	3.8	5.1	3.45	3.65	3.9	7.4	8.2	5.85	4.5	4.0	3.6	3.5
8	3.8	4.25	3.45	3.5	3.9	7.6	8.05	5.8	4.55	3.9	3.6	3.5
9	3.9	4.25	3.45	3.42	3.9	7.25	8.1	5.7	4.5	3.9	3.6	3.5
10	5.1	4.25	3.4	3.55	4.15	6.95	7.95	5.6	4.5	3.9	3.6	3.5
11	5.1	4.25	3.4	3.55	4.5	6.6	7.75	5.4	4.5	3.9	3.55	3.5
12	5.1	4.25	3.4	3.6	5.1	6.55	7.85	5.4	4.5	3.9	3.5	3.5
13	5.1	4.25	3.35	3.7	4.8	6.7	7.65	5.15	4.5	3.9	3.5	3.5
14	5.1	4.25	3.35	3.7	4.7	6.45	7.45	5.0	4.4	3.9	3.5	3.5
15	5.1	3.6	3.35	3.78	4.8	6.95	7.55	4.9	4.4	3.85	3.5	3.5
16	5.1	3.6	3.35	3.9	5.55	7.15	7.45	4.9	4.3	3.85	3.5	3.5
17	5.1	3.6	3.4	4.1	5.65	6.8	6.85	4.9	4.3	3.8	3.7	3.5
18	5.1	3.6	3.4	4.1	6.0	6.65	6.45	5.0	4.2	3.8	3.7	3.5
19	5.1	3.6	3.4	3.8	6.0	6.85	6.8	4.9	4.2	3.8	3.6	3.5
20	5.1	3.6	3.4	3.75	6.25	7.1	6.9	4.85	4.2	3.8	3.6	3.5
21	5.1	3.6	3.7	3.75	6.35	7.4	7.05	4.8	4.1	3.8	3.6	3.5
22	5.1	3.65	3.7	3.7	6.6	7.55	7.25	4.8	4.1	3.75	3.6	3.5
23	5.1	3.6	3.7	3.7	6.65	7.65	7.35	4.7	4.0	3.75	3.6	3.5
24	5.1	3.6	3.6	3.7	6.3	6.9	7.15	4.65	4.0	3.75	3.6	3.5
25	5.1	3.6	3.6	3.8	6.0	6.7	7.45	4.55	3.9	3.75	3.6	3.5
26	5.1	3.6	3.6	3.8	5.75	6.6	7.5	4.6	3.9	3.7	3.6	3.5
27	5.1	3.6	3.6	3.8	5.1	6.8	7.45	4.55	4.1	3.7	3.6	3.5
28	5.1	3.52	3.6	3.8	5.15	7.2	6.85	4.5	4.1	3.7	3.6	3.5
29	5.1	.....	3.65	3.75	5.2	8.15	6.6	4.9	4.55	3.7	3.6	3.5
30	5.1	.....	3.65	3.75	5.3	7.85	6.5	4.85	4.45	3.7	3.6	3.5
31	5.1	.....	3.65	.....	5.65	.....	6.4	4.8	.....	3.7	.....	3.5
1908.												
1	3.5	.....	3.2	3.4	4.25	6.95	7.65	5.4	4.4	3.9	3.9	3.5
2	3.5	.....	3.2	3.4	4.4	6.55	7.5	5.4	4.3	3.9	3.9	3.5
3	3.5	.....	3.2	3.45	4.9	7.05	7.8	5.3	4.3	3.9	3.9	3.5
4	3.5	.....	3.2	3.48	5.0	6.4	7.85	5.3	4.2	4.05	3.9	3.5
5	3.5	.....	3.4	3.4	4.9	5.85	8.4	5.3	4.15	4.2	3.9	3.5
6	3.5	.....	3.4	3.42	5.0	5.9	7.95	5.2	4.1	4.1	3.85	3.5
7	3.5	.....	3.4	3.45	5.35	6.2	7.45	5.2	4.1	4.1	3.85	3.6
8	3.5	.....	3.4	3.5	5.9	6.55	7.1	5.2	4.0	4.1	3.85	3.6
9	3.5	.....	3.4	3.5	6.05	6.4	7.1	5.2	3.9	4.1	3.85	3.6
10	3.5	.....	3.45	3.52	6.15	6.6	7.5	5.0	3.9	4.1	3.85	3.6
11	3.5	.....	3.5	3.55	5.6	7.4	7.4	4.8	3.95	4.1	3.8	3.6
12	3.5	.....	3.5	3.55	5.05	7.85	7.25	5.4	4.05	4.1	3.8	3.6
13	3.5	.....	3.5	3.58	4.95	7.85	7.1	5.5	4.1	4.1	3.8	3.6
14	3.5	3.5	3.5	3.65	4.85	7.75	6.85	5.45	4.1	4.1	3.8	3.6
15	3.5	3.5	3.5	3.8	4.75	8.15	6.8	5.05	4.0	4.1	3.8	3.6

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Daily gage height, in feet, of Clark Fork at Fromberg, Mont., for 1907 and 1908—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
16	3.5	3.5	3.5	4.5	4.7	8.05	6.7	4.8	4.0	4.1	3.8	3.5
17	3.5	3.2	3.5	4.5	4.6	7.6	6.6	4.8	4.0	4.1	3.8	.....
18	3.5	3.2	3.5	4.15	4.55	7.35	6.4	4.8	4.05	4.1	3.8	.....
19	3.5	3.2	3.5	4.5	4.6	6.5	6.4	4.8	4.05	4.1	3.7	.....
20	3.5	3.2	3.5	4.45	4.9	6.75	6.25	5.05	4.0	4.1	3.7	.....
21	3.5	3.2	3.5	5.1	5.4	7.15	5.95	4.8	4.0	4.0	3.7	.....
22	3.5	3.2	3.5	4.95	4.62	6.25	5.85	4.7	4.0	4.0	3.7	.....
23	3.5	3.2	3.5	5.05	4.8	6.4	5.85	4.7	4.0	4.0	3.65	.....
24	3.5	3.2	3.5	4.8	5.05	6.3	5.7	4.7	4.0	4.0	3.65	.....
25	3.5	3.2	3.45	5	4.75	6.3	5.7	4.6	4.0	3.9	3.6	.....
26	3.5	3.2	3.45	5.5	4.85	6.65	5.6	4.6	3.9	3.9	3.6	.....
27	3.5	3.2	3.48	4.3	5.1	6.6	5.65	4.5	3.9	3.9	3.5	.....
28	3.5	3.2	3.45	4.25	5.55	6.65	5.6	4.5	3.9	3.9	3.5	.....
29	3.5	3.2	3.45	4.1	5.65	6.75	5.6	4.3	3.9	3.9	3.5	.....
30	.....	.....	3.45	4.1	5.8	7.4	5.5	4.5	3.9	3.9	3.5	.....
31	.....	.....	3.45	.....	6.6	.....	5.45	4.4	.....	3.9	.....	.....

NOTE.—Ice conditions January 4 to February 14, 1907; January 30 to February 13, 1908, and December 17 to 31, 1908. From January 4 to February 14, 1907, there was an open channel in the center above the bridge, but the river was frozen across below; the readings were taken to top of ice and there was considerable backwater effect. During December 17 to 31, 1908, the river was frozen at the gage, but was open in the center.

Rating tables for Clark Fork at Fromberg, Mont.

JUNE 3, 1905, TO JULY 5, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	250	4.50	1,192	5.80	2,819	7.20	5,600
3.30	296	4.60	1,293	5.90	2,975	7.40	6,080
3.40	346	4.70	1,397	6.00	3,135	7.60	6,570
3.50	400	4.80	1,504	6.10	3,300	7.80	7,070
3.60	458	4.90	1,615	6.20	3,475	8.00	7,590
3.70	520	5.00	1,730	6.30	3,660	8.20	8,130
3.80	587	5.10	1,849	6.40	3,850	8.40	8,680
3.90	660	5.20	1,973	6.50	4,050	8.60	9,240
4.00	738	5.30	2,102	6.60	4,260	8.80	9,820
4.10	821	5.40	2,236	6.70	4,470	9.00	10,400
4.20	908	5.50	2,375	6.80	4,690	9.20	10,980
4.30	999	5.60	2,519	6.90	4,910		
4.40	1,094	5.70	2,667	7.00	5,140		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on twelve discharge measurements made during this period, and is well defined between gage heights 3.5 feet and 7.5 feet.

JULY 6, 1907, TO DECEMBER 31, 1908.

3.20	190	4.50	1,000	5.80	2,510	7.20	5,080
3.30	228	4.60	1,085	5.90	2,660	7.40	5,530
3.40	272	4.70	1,175	6.00	2,820	7.60	6,010
3.50	320	4.80	1,270	6.10	2,980	7.80	6,520
3.60	370	4.90	1,370	6.20	3,150	8.00	7,070
3.70	425	5.00	1,470	6.30	3,320	8.20	7,660
3.80	485	5.10	1,580	6.40	3,500	8.40	8,280
3.90	550	5.20	1,700	6.50	3,680	8.60	8,940
4.00	615	5.30	1,820	6.60	3,870	8.80	9,620
4.10	685	5.40	1,950	6.70	4,060	9.00	10,340
4.20	760	5.50	2,080	6.80	4,250		
4.30	835	5.60	2,220	6.90	4,450		
4.40	915	5.70	2,360	7.00	4,650		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during this period and upon the form of the previous curve. It is well ...een gage heights 3.5 feet and 8.0 feet.

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Monthly discharge of Clark Fork at Fromberg, Mont., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
February 15–28	489	412	457	12,700	C.
March	520	321	405	24,900	C.
April	821	357	533	31,700	B.
May	4,360	587	2,030	125,000	A.
June	8,000	3,300	5,140	306,000	A.
July	10,800	3,500	6,180	380,000	A.
August	3,590	1,000	1,850	114,000	A.
September	1,270	550	888	52,800	A.
October	1,000	425	542	33,300	A.
November	425	320	309	22,000	B.
December	370	320	327	20,100	D.
The period				1,120,000	
1908.					
February 14–29	320	190	214	6,790	C.
March	320	190	290	17,800	B.
April	2,080	272	731	43,500	A.
May	3,870	798	1,680	103,000	A.
June	7,510	2,580	4,510	268,000	B.
July	8,280	2,020	4,180	257,000	B.
August	2,080	835	1,440	88,500	A.
September	915	550	645	38,400	A.
October	760	550	634	39,000	B.
November	550	320	458	27,300	B.
December 1–16	370	320	348	11,000	C.
The period				900,000	

NOTE.—Discharges for periods December to March that have been computed on the assumption of open-channel conditions should be accepted with caution, as no definite information in regard to exact ice conditions were obtained.

PRYOR CREEK AT HUNTLEY, MONT.

Pryor Creek rises in the Pryor Mountains in southern Carbon County, Mont., flows northeastward, and enters Yellowstone River from the south about 15 miles northeast of Billings.

The channel is straight with uniform slope for 800 feet above and below the station. The banks are steep and uniformly graded, are clean, and will not overflow. The current is moderate. The bed is composed of clay and gravel and may change somewhat. On the upper portion of the stream some water is diverted for irrigation.

The gaging station was originally established August 6, 1904, to determine the amount of water available for irrigation. On June 15–16, 1906, the creek was turned into a new channel (Pl. VI, *B*) by the United States Reclamation Service, and a station was established on the steel highway bridge crossing this channel one-half mile from the railroad station at Huntley. Since then the gage datum has not been changed.

The stream freezes over during the winter months. Results obtained are good.

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Discharge measurements of Pryor Creek at Huntley, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 8	J. E. Stewart	34	41.6	1.43	34.8
May 30	do	34	61.0	2.00	106
June 22	do	34	48.0	1.91	88.0
July 10	do	34	34.0	1.23	29.8
August 15	do	25	28.0	1.13	24.0
1908.					
March 28	J. E. Stewart	25	35.5	1.32	33.6
May 21	do	42	129	4.14	514
June 15	Raymond Richards	31.5	55.7	1.75	73.3
July 22[a]	do	26.5	12.6	1.01	10.9
October 12	J. E. Stewart	28.5	40.4	1.32	30.4

[a] Made by wading.

Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1907 and 1908.

[Jack O'Neil, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	1.25	1.40	2.27	1.85	1.25	1.22	1.15	1.28	1.10	1.30
2	.....	.....	1.25	1.35	2.30	1.80	1.22	1.20	1.15	1.40	1.10	1.30
3	.....	.....	1.50	1.20	1.80	1.81	1.20	1.20	1.15	2.35	1.10	1.30
4	.....	.....	1.30	1.15	1.55	1.90	1.20	1.20	1.10	2.05	1.10	1.30
5	.....	.....	1.05	1.10	1.55	1.79	1.20	1.20	1.10	1.30	1.10	1.30
6	.....	.....	1.35	1.30	1.55	1.78	1.20	1.20	1.15	1.20	1.10	1.20
7	.....	.....	.95	1.45	1.55	1.84	1.20	1.20	1.15	1.20	1.10	1.20
8	.....	.....	1.35	1.40	1.53	1.76	1.20	1.10	1.18	1.20	1.10	1.40
9	.....	.....	1.35	1.40	1.50	1.72	1.25	1.10	1.18	1.20	1.10	1.40
10	.....	.....	1.05	1.38	1.50	1.68	1.30	1.10	1.20	1.20	1.10	1.40
11	.....	.....	1.10	1.35	1.50	1.62	1.30	1.10	1.15	1.20	1.10	2.00
12	.....	.....	1.05	1.35	1.60	1.62	1.62	1.10	1.10	1.20	1.10	2.00
13	.....	.....	1.05	1.36	3.15	1.62	1.58	1.10	1.18	1.20	1.10	2.00
14	.....	.....	1.10	1.35	2.47	1.52	1.50	.....	1.18	1.20	1.10	2.00
15	.....	4.35	1.05	1.35	1.93	1.54	1.78	.....	1.15	1.15	1.40	1.50
16	.....	4.55	1.10	1.35	1.90	1.50	2.08	.....	1.15	1.10	1.40	1.50
17	.....	3.80	1.10	1.36	1.70	1.50	2.22	.....	1.15	1.10	1.40	1.50
18	.....	3.38	1.15	1.36	1.63	1.50	2.18	.....	1.15	1.10	1.40	1.40
19	.....	4.30	1.15	1.35	1.73	1.50	1.80	.....	1.10	1.10	1.50	1.30
20	.....	4.20	1.18	1.35	1.70	1.50	1.58	.....	1.15	1.10	1.50	1.30
21	.....	3.35	1.12	1.35	1.70	1.58	1.50	.....	1.15	1.10	1.45	1.20
22	.....	2.15	1.10	1.36	1.70	1.70	1.50	.....	1.15	1.10	1.40	1.30
23	.....	1.80	1.12	1.36	1.75	1.78	1.48	.....	1.15	1.10	1.35	1.30
24	.....	1.50	1.08	1.36	1.85	1.80	1.40	.....	1.15	1.10	1.30	1.20
25	.....	1.45	1.08	1.41	2.63	1.62	1.40	.....	1.15	1.10	1.30	1.20
26	.....	1.28	1.18	1.45	4.40	1.40	1.25	.....	1.10	1.10	1.25	1.20
27	.....	1.35	1.22	1.52	3.23	1.38	1.20	.....	1.15	1.10	1.00	1.20
28	.....	1.15	1.15	1.65	2.27	1.30	1.20	.....	1.15	1.10	1.00	1.20
29	.....	.....	1.45	1.81	1.97	1.30	1.20	1.20	1.25	1.10	1.20	1.40
30	.....	.....	1.55	1.94	1.90	1.25	1.22	1.15	1.25	1.10	1.40	1.50
31	.....	.....	1.28	.....	1.90	.....	1.25	1.20	.....	1.10	.....	1.50
1908.												
1	1.50	1.60	3.00	2.80	1.50	3.00	1.40	1.00	1.10	1.29	1.40	1.32
2	1.50	1.60	.....	1.60	1.51	3.40	1.40	1.00	1.20	1.18	1.40	1.30
3	1.50	1.50	.....	1.51	1.50	2.10	1.40	1.00	1.20	1.20	1.40	1.30
4	1.50	1.50	.....	1.50	1.58	1.90	1.40	1.00	1.20	1.20	1.40	1.30
5	1.50	1.50	2.80	1.50	1.40	1.90	1.40	1.00	1.20	1.20	1.40	1.30
6	1.50	1.60	.....	1.40	1.51	1.99	1.40	1.00	1.10	1.20	1.40	.....
7	1.60	1.60	.....	1.48	1.49	1.60	1.40	1.00	1.10	1.20	1.40	.....
8	1.60	1.60	2.80	1.50	1.40	2.10	1.40	1.00	1.10	1.76	1.40	.....
9	1.60	1.60	.....	1.49	1.40	2.00	1.40	1.06	1.10	2.10	1.40	.....
10	1.60	.....	.....	2.00	1.40	2.00	1.40	.90	1.10	1.90	1.39	.....
11	1.60	.....	.....	1.45	1.46	1.80	1.40	.90	1.10	1.90	1.30	.....
12	1.60	.....	2.80	1.52	1.56	1.80	1.20	.90	1.10	1.30	1.30	1.70
13	1.60	.....	.....	1.49	1.48	1.70	1.20	1.00	1.10	1.30	1.29	.....
14	1.60	.....	.....	1.50	1.40	2.00	1.10	1.00	1.10	1.29	1.37	.....
..	1.50	.....	3.00	1.59	1.46	1.70	1.10	.90	1.10	1.29	1.37	.....
	1.50	2.10	.....	1.50	1.96	1.70	1.10	.90	1.10	1.29	1.37	.....
	1.50	.....	.....	1.59	1.90	1.70	1.10	.90	1.10	1.39	1.40	.....
	1.50	.....	.....	1.60	1.58	1.70	1.10	.90	1.10	1.36	1.40	.....
	1.50	.....	.....	1.62	1.48	1.70	1.10	.90	1.10	1.27	1.40	1.70
	1.50	1.60	.....	1.62	1.60	1.70	1.20	1.00	1.10	1.28	1.40	.....

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Daily gage height, in feet, of Pryor Creek at Huntley, Mont., for 1907 and 1908—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
21	1.50	.....	1.40	1.70	4.10	1.70	1.20	1.00	1.10	1.28	1.40	.....
22	1.50	.....	1.40	1.80	3.08	1.70	1.10	1.10	1.10	1.28	1.32	.....
23	1.50	2.00	1.40	2.26	4.10	1.70	1.10	1.10	1.10	1.24	1.50	.....
24	1.50	.....	1.30	2.20	4.86	1.70	1.10	1.10	1.10	1.22	1.40	.....
25	1.60	.....	1.30	2.28	3.60	1.70	1.10	1.10	1.10	1.23	1.40	.....
26	1.60	.....	1.30	1.28	1.90	1.70	.50	1.10	1.10	1.24	1.40	1.75
27	1.60	3.00	1.30	1.28	2.70	1.70	.50	1.10	1.10	1.24	.....	.....
28	1.60	.....	1.32	1.10	4.65	1.50	.50	1.10	1.10	1.23	.....	.....
29	1.60	.....	1.32	1.40	4.45	1.50	.60	1.10	1.10	1.21	1.32	.....
30	1.60	.....	1.32	1.40	3.40	1.40	.80	1.10	1.10	1.30	1.32	.....
31	1.60	.....	1.32	.....	4.70	.....	.90	.....	.....	1.29	.....	.....

NOTE.—Ice conditions January 1 to February 14, 1907, November 15, 1907 to March 21, 1908, and after November 26, 1908.

Rating table for Pryor Creek at Huntley, Mont., for 1907 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	0	1.60	56	2.60	186	3.60	371
.60	1	1.70	67	2.70	202	3.70	393
.70	3	1.80	78	2.80	218	3.80	415
.80	5	1.90	90	2.90	235	3.90	437
.90	8	2.00	102	3.00	253	4.00	460
1.00	11	2.10	115	3.10	271	4.20	507
1.10	15	2.20	128	3.20	290	4.40	555
1.20	20	2.30	142	3.30	309	4.60	605
1.30	27	2.40	156	3.40	329	4.80	655
1.40	36	2.50	171	3.50	350	5.00	705
1.50	46						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 15 discharge measurements made during 1906–1908, and is well defined below gage height 2.5 feet. Above gage height 2.5 feet the rating depends upon one measurement at gage height 4.14 feet.

Monthly discharge of Pryor Creek at Huntley, Mont., for 1907 and 1908.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 15–28	592	18	257	0.321	0.17	7,140	B.
March	51	10	21.2	.026	.03	1,300	B.
April	95	15	36.8	.046	.05	2,190	B.
May	555	46	111	.139	.16	6,820	A.
June	90	24	58.6	.073	.08	3,490	B.
July	131	20	42.4	.053	.06	2,610	B.
August	21	15	18.1	.023	.03	1,110	C.
September	24	15	18.1	.023	.03	1,080	B.
October	149	15	25.3	.032	.04	1,560	B.
November 1–14	15	15	15.0	.019	.01	416	C.
The period	.....	.....	.....	.....	.....	27,700	
1908.							
March 21–31	36	27	30.2	.038	.02	659	B.
April	218	15	62.7	.078	.09	3,730	A.
May	630	36	184	.230	.27	11,300	A.
June	329	36	89.2	.112	.12	5,310	A.
July	36	0	20.6	.026	.03	1,270	B.
August	15	8	11.5	.014	.02	707	C.
September	20	15	15.7	.020	.02	934	C.
October	115	19	33.0	.041	.05	2,030	B.
November	46	26	34.8	.044	.05	2,070	B.
The period	.....	.....	.....	.....	.....	28,000	

NOTE.—Discharge estimated August 14 to 28, 1907 and August 31, November 27 to 30, 1908.

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BIGHORN RIVER DRAINAGE BASIN.

DESCRIPTION.

Bighorn River is formed by the junction of Big and Little Wind rivers near Riverton, Wyo.

Big Wind River rises some 50 miles southeast of the Yellowstone National Park in the mountains of the Shoshone and Wind River ranges, whose highest peaks attain altitudes of more than 12,000 feet, and flows in a general southeasterly direction for about 100 miles to its mouth, where the elevation is 5,100 feet. The upper part of its basin is hilly and mountainous except along the river and its tributaries, where the bottom lands average a mile or so in width. About 40 miles above Riverton the valley broadens out and includes stretches of land several miles in width excellently adapted to agriculture. The most important tributary of Big Wind River is Bull Lake Creek; among other tributaries may be mentioned Red, Dinwoodie, Dry, Willow, and Meadow creeks.

Little Wind River rises on the eastern side of the Wind River Range and flows eastward for about 50 miles to its confluence with Big Wind River. At the junction of the North and South forks of the Little Wind, near Fort Washakie, the valleys of these streams widen out into an excellent agricultural section. Above Fort Washakie the drainage area is generally hilly and mountainous in character.

The principal tributary of Little Wind River is the Popo Agie, which rises in the high mountains and flows in a northeasterly direction to its confluence with the Little Wind River at Arapahoe, Wyo., and which emerges from the mountains about 8 miles above Lander, Wyo. This stream at its mouth is considerably larger than Little Wind River. Important tributaries of the Popo Agie are the North Fork, which enters just below Lander, and the Little Popo Agie, which comes in at Hudson about 10 miles below Lander. The valleys of the Popo Agie and its tributaries are comparatively wide and form one of the oldest irrigated sections of Wyoming. Among the other tributaries of the Little Wind River are St. Lawrence, Sage, and Trout creeks.

From Riverton, Wyo., to its junction with the Yellowstone near Bighorn, Mont., a distance of about 250 miles, the Bighorn flows northward. At Thermopolis, 55 miles below Riverton, the elevation is about 4,200 feet; at the mouth of the Shoshone, 90 miles below Thermopolis, it is 3,800 feet; and at the mouth of the Bighorn it is about 2,700 feet.

Owl Creek, No Wood River, Grey Bull River, Shell Creek, Shoshone River, and Little Bighorn are important tributaries of the Bighorn.

drainage area of the Bighorn River above the mouth of the ıone is about 15,500 square miles.

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The mountainous area drained by the Bighorn and its tributaries contain several hundred square miles of timber land, a great part of which is included in national forests. The remainder of the area, with the exception of occasional strips of land under cultivation, may be classed as range and sagebrush land.

The rainfall seems to vary from 20 inches or more above an altitude of 9,000 feet to an average of 12 to 15 inches at elevations from 4,000 to 7,000 feet. Below an altitude of 4,000 feet the rainfall is locally less than 12 inches.

The winters on the upper Bighorn above an altitude of 4,500 feet are severe. Snowfall is abundant in the high mountains, and heavy snowstorms also take place in the more open country, but in the plains section the snow does not usually remain for long periods. As compared with those in the upper basin the winters in what is called the Bighorn Basin are fairly mild. This basin begins where the river emerges from the canyon above Thermopolis and extends nearly to the mouth of the river. Most of the lower drainage area of Shoshone River is included in this basin. This belt is subject to the influence of the so-called chinook winds. Nearer the mouth of the stream the winters are more severe.

Irrigation along Bighorn River is developing very rapidly. For a number of years irrigation has been practiced in comparatively restricted tracts at various points along the stream and its tributaries, as in the Lander and Thermopolis districts in Wyoming, and in the Crow Reservation in Montana, as well as on the No Wood, Grey Bull, Shoshone, and other tributaries; but such irrigation has used only a small part of the total flow of these streams. Extensive irrigation works now being constructed by the Indian Service on the Shoshone Reservation in Wyoming and the Crow Reservation in Montana will eventually serve probably 225,000 acres; the Shoshone project of the United States Reclamation Service will provide for the irrigation of more than 125,000 acres along Shoshone River; by using some of the storage sites on Big Wind River the Wyoming Central Irrigation Company will irrigate several hundred thousand acres of land near Riverton, and other private enterprises will irrigate considerable land near Basin. Many opportunities for additional projects are to be found on the tributary streams.

As a large part of the drainage area of Bighorn River has never been carefully surveyed, the full extent of the storage possibilities is not very well known, but undoubtedly many excellent reservoir sites exist at the headwaters of Big Wind and Little Wind rivers. Among others may be mentioned the site on Bull Lake Creek, which is situated at a natural lake on this stream, and many similar lakes are to be found in that locality. It is believed that very good sites can be found for storing the flood waters of Paint Rock, Owl Creek,

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Shell Creek, and Grey Bull River. Many of these streams have a large annual run-off, but some of them are intermittent in character.

Probably the best reservoir site in the area is the one which the Reclamation Service is now developing on Shoshone River 8 miles above Cody, Wyo. With a dam 310 feet high above foundation, the reservoir will have a capacity of 456,000 acre-feet. (See Pls. VIII and IX.)

The value of the land along the Bighorn River and its tributaries for agriculture will probably restrict water-power development to streams of the headwater regions. The fall of many of these streams exceeds 300 feet to the mile. Popo Agie and Little Wind rivers probably afford the best opportunities. In the canyon of the Bighorn above Thermopolis, where the Big Horn Company is now constructing a plant with a capacity of about 5,000 horsepower, at least 25,000 horsepower can be developed. Of the 100,000 horsepower or more which might easily be developed, probably less than 1,000 horsepower are now being utilized.

For gaging stations maintained in this basin see page 143.

BIG WIND RIVER NEAR RIVERTON, WYO.[a]

This station was established May 14, 1906, to determine the amount of water available for storage and irrigation, and was abandoned October 25, 1908, but records are available for only part of this period. It was located at Walker's ferry, 7 miles northeast of Arapahoe, about 2 miles above Riverton, and 2 miles above the mouth of Little Wind River.

Except for the canal systems of the United States Indian Service, which divert water from several tributaries, present diversions above this station are limited to one canal of the Wyoming Central Irrigation Company, which irrigates probably 20,000 acres. Other canals under construction or contemplation by this company will eventually divert water for the irrigation of several hundred thousand acres.

Ice prevails for several months during the winter season, but no winter records were kept.

On July 13, 1906, a new gage was installed, differing in location and datum from the original gage. This gage was replaced on August 24, 1907, by another gage, near the site of the original gage and as nearly as could be determined at the same datum, and this last datum was used until the station was abandoned.

Very good discharge measurements were obtained at this station, and the results are considered very satisfactory, though the channel shifts considerably during floods.

[a] Referred to in Water-Supply Paper 208 as "near Arapahoe Agency."

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A. SHOSHONE DAM SITE, SHOSHONE RIVER, WYOMING.

B. SHOSHONE DAM, SHOSHONE RIVER, WYOMING.

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Discharge measurements of Big Wind River near Riverton, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 24	W. B. Freeman	231	449	2.02	1,740
October 19	do	225	274	1.06	685
1908.					
June 16	W. B. Freeman	232	1,040	4.78	7,840
July 24	J. B. Stewart	234	620	2.90	3,600
August 27	do	173	588	1.50	1,760
November 6	W. B. Freeman	106	153	—0.21	578

Daily gage height, in feet, of Big Wind River near Riverton, Wyo., for 1907 and 1908.

[Andrew Walker, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.						1907.					
1		2.15	1.30	1.00	0.98	16		1.08	.....	0.85	1.00
2		1.42	1.30	.95	.95	17		1.09	.....	.85	1.28
3		1.45	1.30	.95	.95	18		1.02	.....	.80	1.55
4		1.38	1.28	.95	.95	19		1.09	1.05	.80	1.55
5		1.35	1.20	.95	.95	20		1.09	1.05	.72	1.55
6		1.40	1.20	.95	.95	21		1.09	1.05	.62	1.55
7		1.42	1.25	.95	.95	22		1.35	1.05	.72	1.55
8		1.40	1.22	.90	.95	23		1.22	1.05	.80	1.55
9		1.32	1.20	.90	.95	24	2.04	1.25	1.05	.85	1.55
10		1.30	1.15	.90	.98	25	2.30	1.25	1.05	.90	1.90
11		1.20	1.12	.90	1.00	26	2.15	1.25	1.05	.90	1.90
12		1.12	1.10	.85	1.00	27	2.32	1.25	1.05	1.00	2.05
13		1.12	1.10	.85	1.00	28	2.30	1.25	1.05	1.00	2.05
14		1.12	1.15	.85	1.00	29	2.20	1.32	1.05	1.00	2.05
15		1.08	1.12	.85	1.00	30	2.18	1.38	1.05	1.00	2.05
						31	2.12	.....	1.00	.....	2.05

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1908.							1908.						
1	1.1	2.8	3.95	2.85	0.8	0.4	16	1.65	4.75	3.7	2.3	0.6	0.35
2	1.15	2.4	3.9	2.75	.6	.5	17	1.6	4.7	3.5	2.1	.7	.4
3	1.25	2.2	4.1	2.75	.55	.6	18	1.6	4.2	3.45	1.9	.7	.3
4	1.5	2.1	4.2	2.7	.5	.6	19	1.5	3.9	3.4	1.9	.7	.3
5	1.5	2.0	4.6	2.6	.4	.7	20	1.65	3.5	3.4	1.95	.6	.25
6	1.55	1.95	4.2	2.6	.4	.7	21	1.7	3.05	3.35	1.9	.5	.2
7	1.8	2.05	4.0	2.55	.45	.6	22	1.6	2.9	3.15	2.1	.4	.15
8	2.0	2.6	3.9	2.5	.5	.5	23	1.75	2.8	3.1	2.2	.3	.15
9	2.3	2.6	4.0	2.35	.6	.6	24	1.85	2.65	3.05	2.05	.25	.1
10	2.5	2.8	4.2	2.2	.65	.55	25	1.7	3.1	3.05	1.8	.35	.15
11	2.05	3.4	4.2	2.1	.7	.5	26	1.9	3.6	2.95	1.6	.5	.....
12	1.85	3.8	3.95	2.2	.7	.45	27	2.05	4.1	2.9	1.5	.5	.....
13	1.8	4.1	3.9	2.1	.7	.4	28	1.9	4.1	3.05	1.2	.4	.....
14	1.8	4.3	3.75	2.2	.7	.4	29	1.8	3.6	3.1	1.1	.5	.....
15	1.65	4.6	3.7	2.6	.65	.4	30	1.8	3.75	3.05	.95	.5	.....
							31	2.05	.....	3.0	.9	.....	.....

NOTE.—River frozen, December 17 to 31, 1907. The channel was away from the gage after October 25, 1908

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Rating tables for Big Wind River near Riverton, Wyo.

AUGUST 24, 1907, TO JULY 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	380	1.60	1,200	2.60	2,680	3.60	4,900
.70	435	1.70	1,320	2.70	2,870	3.70	5,160
.80	500	1.80	1,440	2.80	3,070	3.80	5,430
.90	570	1.90	1,570	2.90	3,280	3.90	5,710
1.00	640	2.00	1,710	3.00	3,500	4.00	6,000
1.10	720	2.10	1,860	3.10	3,720	4.20	6,580
1.20	800	2.20	2,010	3.20	3,950	4.40	7,170
1.30	890	2.30	2,170	3.30	4,180	4.60	7,780
1.40	990	2.40	2,330	4.40	4,410	4.80	8,430
1.50	1,090	2.50	2,500	3.50	4,650		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907–8 and the form of the 1906 curve, and is well defined between gage heights 1.0 foot and 5.0 feet.

JULY 6, TO OCTOBER 25, 1908.

Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	760	1.10	1,430	2.10	2,430	3.10	3,950
.20	820	1.20	1,510	2.20	2,560	3.20	4,140
.30	880	1.30	1,590	2.30	2,700	3.30	4,340
.40	945	1.40	1,670	2.40	2,840	3.40	4,550
.50	1,010	1.50	1,760	2.50	2,980	3.50	4,760
.60	1,075	1.60	1,850	2.60	3,130	3.60	4,980
.70	1,140	1.70	1,950	2.70	3,280	3.70	5,220
.80	1,210	1.80	2,060	2.80	3,440	3.80	5,470
.90	1,280	1.90	2,180	2.90	3,600	3.90	5,730
1.00	1,350	2.00	2,300	3.00	3,770	4.00	6,000

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period, and is fairly well defined. Above gage height 4.0 feet it is the same as the preceding table.

Monthly discharge of Big Wind River near Riverton, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
August 24–31	2,200	1,770	2,020	32,100	A.
September	1,940	656	882	52,500	A.
October	890	640	741	45,600	A.
November	640	391	559	33,300	B.
December	640	605	630	38,700	D.
The period				202,000	
1908.					
May	2,500	720	1,390	85,500	A.
June	8,260	1,640	4,370	260,000	A.
July	7,780	3,600	5,110	314,000	A.
August	3,520	1,280	2,480	152,000	A.
September	1,210	850	1,040	61,900	B.
October	1,140	680	909	55,900	C.
The period				929,000	

NOTE.—Discharge estimated October 16 to 18, December 17 to 31, 1907, and October 26 to 31, 1908. The Wyoming Central canal was carrying 30 second-feet August 24, 1907, and 10 second-feet on October 18, 1907.

BIGHORN RIVER NEAR HARDIN, MONT.[a]

[illegible] tion, which was established June 16, 1904, to determine the ater available for irrigation, is located at the bridge of on and Missouri River Railroad about one-half mile

[a] Referred to as at "Fort Custer" in Water-Supply Paper 208, p. 96.

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above the junction of Bighorn and Little Bighorn rivers, and 2 miles from Hardin. Water is diverted a few miles above the station by a private irrigation company to irrigate land on the west side of the river.

The river freezes over during the winter months.

The present gage datum is 3 feet higher than that of the original gage; but on August 10, 1905, the gage was moved to the west span of the bridge and the datum lowered 2 feet. Gaging conditions at this station are good. The bed of the stream is of gravel, and is free from vegetation.

Discharge measurements of Bighorn River near Hardin, Mont., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	J. E. Stewart	419	1,270	3.00	1,800
May 29	do	433	2,360	5.20	9,290
June 21	do	435	3,060	6.80	17,600
August 14	do	432	2,320	5.11	7,340
August 27	Robert Follansbee	431	1,960	4.40	4,100
September 30	J. E. Stewart	422	1,720	3.81	2,560
1908.					
March 27	J. E. Stewart	430	1,550	3.49	1,860
May 20	do	437	2,110	4.80	6,730
June 16	Raymond Richards	447	3,790	7.97	26,400
July 21	do	439	2,830	5.83	11,700
October 13	J. E. Stewart	429	1,780	3.92	3,270

Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1907 and 1908.

[J. S. Tupper, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1		2.90	3.55	5.82	7.35	6.35	4.60	3.80	3.60
2		2.90	3.60	5.52	7.40	6.25	4.55	3.75	3.60
3		2.95	3.55	5.52	7.95	6.20	4.50	3.70	3.55
4		3.00	3.58	5.75	8.45	6.15	4.40	3.70	3.55
5		3.00	3.52	5.92	8.50	6.45	4.30	3.70	3.55
6		3.00	3.55	6.28	8.65	6.10	4.20	3.65	3.50
7		3.05	3.55	6.52	8.45	5.95	4.15	3.65	3.50
8		3.05	3.55	6.95	8.35	5.90	4.10	3.70	3.50
9		3.00	3.52	7.30	8.50	5.80	4.10	3.80	3.50
10		2.95	3.52	7.18	8.45	5.65	4.05	3.85	3.50
11		2.98	3.70	7.02	8.15	5.25	4.00	3.85	3.50
12		3.05	4.12	6.82	7.90	5.10	4.00	3.80	3.55
13		3.15	4.50	6.78	7.65	4.95	3.95	3.75	3.55
14		3.10	4.65	6.75	7.45	4.90	3.95	3.75	3.55
15		3.15	4.48	6.70	7.45	4.80	3.90	3.70	3.50
16		3.15	4.38	6.60	7.35	4.80	3.85	3.70	3.50
17		3.45	4.50	6.65	7.30	4.75	3.85	3.70	3.45
18		3.48	5.00	6.50	7.25	4.70	3.85	3.70	3.45
19		3.45	5.12	6.30	7.20	4.70	3.80	3.70	3.40
20		3.45	5.35	6.40	7.15	4.75	3.80	3.70	3.40
21		3.45	5.58	6.80	7.00	4.60	3.80	3.70	3.35
22		3.35	5.75	7.00	6.85	4.55	3.75	3.65	3.35
23		3.25	6.25	7.30	6.75	4.50	3.75	3.60	3.35
24		3.25	6.68	7.05	6.55	4.50	3.70	3.60	3.35
25		3.30	6.72	6.90	6.50	4.45	3.65	3.60	3.40
26		3.32	7.15	6.65	6.45	4.45	3.65	3.60	3.40
27		3.45	7.10	6.60	6.45	4.40	3.65	3.60	3.40
28		3.75	6.98	6.70	6.40	.....	3.65	3.60	3.35
29		3.70	6.40	6.90	6.40	.....	3.75	3.60	3.35
30		3.65	5.98	7.10	6.50	.....	3.80	3.60	3.35
31		.....	5.78	.....	6.45	.....	.....	3.60	.....

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Rating tables for Big Wind River near Riverton, Wyo.

AUGUST 24, 1907, TO JULY 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	380	1.60	1,200	2.60	2,680	3.60	4,900
.70	435	1.70	1,320	2.70	2,820	3.70	5,160
.80	500	1.80	1,440	2.80	3,070	3.80	5,430
.90	570	1.90	1,570	2.90	3,290	3.90	5,710
1.00	640	2.00	1,710	3.00	3,500	4.00	6,000
1.10	720	2.10	1,860	3.10	3,720	4.20	6,580
1.20	800	2.20	2,010	3.20	3,950	4.40	7,170
1.30	880	2.30	2,170	3.30	4,180	4.60	7,780
1.40	960	2.40	2,330	4.40	4,410	4.80	8,430
1.50	1,080	2.50	2,500	3.50	4,650		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907–8 and the form of the 1906 curve, and is well defined between gage heights 1.0 feet and 5.0 feet.

JULY 6, TO OCTOBER 25, 1908.

Feet	Sec.-ft	Feet	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
0.10	760	1.10	1,430	2.10	2,430	3.10	3,950
.20	830	1.20	1,510	2.20	2,560	3.20	4,140
.30	880	1.30	1,590	2.30	2,700	3.30	4,340
.40	945	1.40	1,670	2.40	2,840	3.40	4,550
.50	1,010	1.50	1,760	2.50	2,980	3.50	4,760
.60	1,075	1.60	1,850	2.60	3,130	3.60	4,980
.70	1,140	1.70	1,950	2.70	3,280	3.70	5,220
.80	1,210	1.80	2,060	2.80	3,440	3.80	5,470
.90	1,280	1.90	2,180	2.90	3,600	3.90	5,730
1.00	1,350	2.00	2,300	3.00	3,770	4.00	6,000

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during this period, and is fairly well defined. Above gage height 4.0 feet the same as the preceding table.

Monthly discharge of Big Wind River near Riverton, Wyo., for 1907 and 1908.

Month	Discharge in second-feet.			Run-off (total in acre-feet)
	Maximum.	Minimum.	Mean.	
1907.				
August 24–31	2,200	1,770	2,020	32,1
September	1,940	656	882	52,5
October	880	640	741	45,6
November	640	391	559	33,2
December	640	605	630	38,7
The period				202,0
1908.				
May	2,500	720	1,380	85,0
June	8,280	1,640	4,370	259,9
July	7,780	3,600	5,110	314,2
August	3,520	1,280	2,480	152,5
September	1,210	850	1,040	61,9
October	1,140	680	909	55,9
The period				929,4

NOTE.—Discharge estimated October 16 to 18, December 17 to 31, 1907, and October 26 to [illegible]. Wyoming Central canal was carrying 30 second-feet August 24, 1907, and 10 second-feet on Octo[illegible]

BIGHORN RIVER NEAR HARDIN, MONT.[a]

This station, which was established [illegible] 16, 1904, to deter[illegible] amount of water available fo[illegible] the Burlington and Miss[illegible]

[a] Referred to as r[illegible]

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the junction of Bighorn and Little Bighorn rivers, and 2 miles Hardin. Water is diverted a few miles above the station by a irrigation company to irrigate land on the west side of the

river freezes over during the winter months.

present gage datum is 3 feet higher than that of the original out on August 10, 1905, the gage was moved to the west span bridge and the datum lowered 2 feet.' Gaging conditions at tion are good. The bed of the stream is of gravel, and is free egetation.

urge measurements of Bighorn River near Hardin, Mont., in 1907 and 1908.

	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
.....	J. E. Stewart	419	1,270	3.00	1,800
.....	do	433	2,360	5.20	9,290
.....	do	435	3,060	6.80	17,600
30..	Robert Follansbee	432	2,320	5.11	7,340
	J. E. Stewart	431	1,980	4.40	4,100
		422	1,720	3.81	2,560
.....	J. E. Stewart	430	1,550	3.49	1,860
.....	do	437	2,110	4.80	6,730
.....	Raymond Richards	447	3,790	7.97	26,400
.....	do	439	2,830	5.83	11,700
.....	J. E. Stewart	429	1,780	3.92	3,270

gage height, in feet, of Bighorn River near Hardin, Mont., for 1907 and 1908.

[J. S. Tupper, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
		2.90	3.55	5.82	7.35	6.35	4.60	3.80	3.60
		2.90	3.60	5.52	7.40	6.25	4.55	3.75	3.60
		2.95	3.55	5.52	7.95	6.20	4.50	3.70	3.55
		3.00	3.58	5.75	8.45	6.15	4.40	3.70	3.55
		3.00	3.52	5.92	8.50	6.45	4.30	3.70	3.55
		3.00	3.55	6.28	8.15	6.10	4.20	3.65	3.50
		3.05	3.55	6.52	8.45	5.95	4.15	3.65	3.50
		3.05	3.55	6.95	8.35	5.90	4.10	3.70	3.50
		3.00	3.52	7.30	8.50	5.80	4.10	3.80	3.50
		2.95	3.52	7.18	8.45	5.65	4.05	3.85	3.50
		2.98	3.70	7.02	8.15	5.25	4.00	3.85	3.50
		3.05	4.12	6.82	7.90	5.10	4.00	3.80	3.55
		3.15	4.50	6.78	7.65	4.95	3.95	3.75	3.55
		3.10	4.65	6.75	7.45	4.90	3.95	3.75	3.55
		3.15	4.48	6.70	7.45	4.80	3.90	3.70	3.50
		3.15	4.38	6.60	7.35	4.80	3.85	3.70	3.50
		3.45	4.50	6.65	7.30	4.75	3.85	3.70	3.45
		3.48	5.00	6.50	7.25	4.70	3.85	3.70	3.45
		3.45	5.12	6.30	7.20	4.70	3.80	3.70	3.40
		3.45	5.35	6.40	7.15	4.75	3.80	3.70	3.40
		3.45	5.58	6.80	7.00	4.60	3.80	3.70	3.35
		3.33	5.75	7.00	6.85	4.55	3.75	3.65	3.35
		3.25	6.25	7.30	6.75	4.50	3.75	3.60	3.35
		3.25	6.08	7.05	6.65	4.50	3.70	3.60	3.35
		3.20	6.22	7.00	6.65	4.60	3.65	3.60	3.35
		3.40							3.40
		3.45							3.40
		3.45							3.40
		3.50							3.35
		3.50							3.35
		3.48							3.35

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Daily gage height, in feet, of Bighorn River near Hardin, Mont., for 1907 and 1908—Con.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
1	.....	3.25	3.95	6.00	7.00	5.20	4.10	3.70	3.60
2	.....	3.20	3.90	6.60	7.20	5.20	4.00	3.70	3.60
3	.....	3.15	3.90	6.00	7.30	5.10	4.00	3.80	3.60
4	.....	3.15	3.90	7.40	7.20	4.90	3.90	3.80	3.50
5	.....	3.15	3.80	6.80	7.20	4.90	3.90	3.80	3.50
6	.....	3.10	3.80	6.40	7.20	4.90	3.90	3.90	3.50
7	.....	3.10	4.10	6.40	7.10	4.80	3.80	4.00	3.50
8	.....	3.10	4.30	6.50	7.00	4.70	3.80	4.10	3.50
9	.....	3.15	4.50	6.80	6.80	4.60	3.70	4.10	3.40
10	.....	3.20	4.70	7.10	6.80	4.60	3.70	4.00	3.40
11	.....	3.20	4.70	7.40	6.80	4.50	3.70	4.00	3.30
12	.....	3.30	4.60	8.00	6.70	4.60	3.60	3.90	3.30
13	.....	3.40	4.50	8.00	6.70	4.60	3.60	3.90	3.30
14	.....	3.45	4.40	8.00	6.60	4.60	3.70	4.00	3.30
15	.....	3.50	4.40	8.80	6.50	4.70	3.70	4.00	3.30
16	.....	3.60	4.50	9.10	6.40	5.10	3.80	4.00	3.20
17	.....	3.80	4.50	9.80	6.30	5.00	3.90	3.90	3.20
18	.....	3.90	4.60	9.20	6.20	4.90	3.90	3.90	3.30
19	.....	4.00	4.60	8.40	6.00	4.80	3.80	3.80	3.40
20	.....	4.20	4.80	8.00	5.90	4.80	3.70	3.80	3.40
21	3.50	4.30	4.90	7.80	5.80	4.80	3.70	3.70	3.50
22	3.50	4.50	5.00	7.70	5.70	4.70	3.70	3.70	3.50
23	3.50	4.50	5.00	7.20	5.60	4.70	3.80	3.70	3.50
24	3.50	4.40	4.90	7.00	5.50	4.70	3.90	3.70	3.60
25	3.40	4.40	4.90	6.90	5.40	4.60	3.90	3.70	3.60
26	3.35	4.30	4.80	6.80	5.30	4.60	3.80	3.70	3.60
27	3.30	4.25	4.80	6.70	5.20	4.40	3.80	3.60	3.70
28	3.30	4.15	4.90	6.70	5.20	4.30	3.70	3.60	3.70
29	3.30	4.05	5.00	6.70	5.20	4.30	3.70	3.60	3.70
30	3.30	4.05	5.00	6.90	5.20	4.20	3.70	3.60	3.70
31	3.25	.....	5.40	.....	5.20	4.20	.....	3.60	.....

NOTE.—Probable ice conditions January to March, December, 1907 and January 1 to March 20, December, 1908.

Rating tables for Bighorn River near Hardin, Mont.

APRIL 1 TO JULY 25, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	1,560	4.10	4,930	5.30	9,380	6.80	17,760
3.00	1,800	4.20	5,260	5.40	9,820	7.00	19,140
3.10	2,040	4.30	5,600	5.50	10,280	7.20	20,560
3.20	2,290	4.40	5,950	5.60	10,760	7.40	22,040
3.30	2,550	4.50	6,300	5.70	11,260	7.60	23,580
3.40	2,820	4.60	6,660	5.80	11,780	7.80	25,160
3.50	3,100	4.70	7,030	5.90	12,300	8.00	26,800
3.60	3,390	4.80	7,400	6.00	12,840	8.20	28,450
3.70	3,680	4.90	7,780	6.20	13,980	8.40	30,110
3.80	3,980	5.00	8,170	6.40	15,180	8.60	31,780
3.90	4,290	5.10	8,560	6.60	16,440	8.80	33,460
4.00	4,610	5.20	8,960				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during 1907 and the 1906 curve. It is fairly well defined between gage heights 2.9 feet and 7.0 feet. Above gage height 5.0 feet it is the same as the 1906 table.

JULY 26 TO NOVEMBER 30, 1907.

3.30	1,440	4.20	3,510	5.00	6,750	5.80	11,170
3.40	1,590	4.30	3,840	5.10	7,260	5.90	11,800
3.50	1,760	4.40	4,190	5.20	7,780	6.00	12,440
3.60	1,950	4.50	4,550	5.30	8,310	6.10	13,090
3.70	2,160	4.60	4,930	5.40	8,850	6.20	13,750
3.80	2,390	4.70	5,340	5.50	9,400	6.30	14,420
3.90	2,640	4.80	5,780	5.60	9,970	6.40	15,100
4.00	2,910	4.90	6,250	5.70	10,560	6.50	15,800
4.10	3,200						

—The above table is not applicable for ice or obstructed-channel conditions. It is based on three [redacted]ements made during 1907 and form of previous curves. It is well defined above gage

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Rating tables for Bighorn River near Hardin, Mont.—Continued.

FOR 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	1,220	4.50	5,300	5.90	12,070	7.60	23,540
3.20	1,380	4.60	5,720	6.00	12,660	7.80	25,040
3.30	1,550	4.70	6,150	6.10	13,260	8.00	26,560
3.40	1,740	4.80	6,590	6.20	13,880	8.20	28,100
3.50	1,960	4.90	7,040	6.30	14,510	8.40	29,660
3.60	2,200	5.00	7,500	6.40	15,150	8.60	31,230
3.70	2,470	5.10	7,970	6.50	15,800	8.80	32,810
3.80	2,770	5.20	8,440	6.60	16,460	9.00	34,400
3.90	3,090	5.30	8,920	6.70	17,130	9.20	36,000
4.00	3,430	5.40	9,410	6.80	17,810	9.40	37,600
4.10	3,780	5.50	9,910	6.90	18,500	9.60	39,200
4.20	4,140	5.60	10,420	7.00	19,200	9.80	40,800
4.30	4,510	5.70	10,950	7.20	20,610		
4.40	4,900	5.80	11,500	7.40	22,060		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908 and is well defined.

Monthly discharge of Bighorn River near Hardin, Mont., for 1907 and 1908.

[Drainage area, 20,700 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April	3,830	1,560	2,380	0.115	0.13	142,000	A.
May	20,200	3,160	8,660	.418	.48	532,000	A.
June	21,300	10,400	16,700	.807	.90	994,000	A.
July	32,200	15,100	22,300	1.08	1.24	1,370,000	A.
August	15,400	4,190	7,770	.375	.43	478,000	A.
September	4,930	2,060	2,900	.140	.16	173,000	A.
October	2,520	1,950	2,150	.104	.12	132,000	A.
November	1,950	1,520	1,700	.082	.09	101,000	B.
The period						3,920,000	
1908.							
March 21–31	1,960	1,460	1,720	.083	.03	37,500	B.
April	5,300	1,220	2,740	.132	.15	163,000	A.
May	9,410	2,770	5,620	.271	.31	346,000	A.
June	40,800	12,700	22,600	1.09	1.22	1,340,000	A.
July	21,300	8,440	14,600	.705	.81	898,000	A.
August	8,440	4,140	6,230	.301	.35	383,000	A.
September	3,780	2,200	2,770	.134	.15	165,000	A.
October	3,780	2,200	2,850	.138	.16	175,000	A.
November	2,470	1,380	1,930	.093	.10	115,000	B.
The period						3,620,000	

NOTE.—Discharge estimated for period August 28 to 31, 1907.

LITTLE WIND RIVER AT FORT WASHAKIE, WYO.

This station, which was established October 31, 1908, to obtain data for the use of the Indian Service in connection with irrigation development, is located about three-fourths of a mile below the junction of North and South forks, and 1 mile below Fort Washakie post-office. The river freezes during the winter.

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Discharge measurements of Little Wind River at Fort Washakie, Wyo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 8	John Gonin	.....	74	.....	136
October 30	Freeman and Gonin	54	77	1.93	124
December 29 [a]	R. L. Cooper	55	103	2.50	92

[a] Ice conditions.

Daily gage height, in feet, of Little Wind River at Fort Washakie, Wyo., for 1908.

[J. J. Guyer, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	1.9	2.0	11	.....	1.85	2.3	21	.....	1.9	2.55
2	.....	1.95	1.8	12	.....	1.75	2.35	22	.....	1.8	2.5
3	.....	1.9	2.3	13	.....	1.75	2.35	23	.....	1.7	2.55
4	.....	1.9	2.3	14	.....	1.95	2.35	24	.....	1.75	2.5
5	.....	1.9	2.25	15	.....	2.05	2.35	25	.....	1.7	2.55
6	.....	1.9	2.2	16	.....	2.15	2.35	26	.....	1.75	2.55
7	.....	1.9	2.2	17	.....	2.1	2.4	27	.....	1.9	2.5
8	.....	1.9	2.25	18	.....	2.05	2.3	28	.....	1.8	2.5
9	.....	1.9	2.25	19	.....	2.0	2.55	29	.....	1.9	2.5
10	.....	1.8	2.3	20	.....	1.9	2.6	30	.....	2.1	2.5
								31	1.9	.....	2.4

NOTE.—Ice conditions probably began November 30.

LITTLE WIND RIVER ABOVE ARAPAHOE, WYO.

This station, which was established May 11, 1906, to determine the amount of water available for irrigation and storage, is located at the government bridge a short distance above the mouth of the Popo Agie River and about one-half mile west of the post-office at Arapahoe. The drainage area is about 650 square miles.

Water is diverted from Little Wind River and various tributaries above the station by the United States Indian Service canal systems, which will eventually irrigate several thousand acres of land. Some of the canals are already in operation.

The datum of the gage has not been changed since the station was established. Fair results have been obtained, but measurements are somewhat affected by the pile bents of the bridge. The river is ice-bound for several months during the winter season.

Discharge measurements of Little Wind River above Arapahoe, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 25	W. B. Freeman	100	122	1.40	304
October 21 [a]	....do	57.5	65	.90	106
1908.					
June 15	W. B. Freeman	103	327	3.45	1,630
July 24	J. B. Stewart	102	197	2.05	643
July 25	....do	102	195	2.07	637
August 26	....do	111	169	1.80	446
November 5 [a]	W. B. Freeman	58	78	1.09	142

[a] Made by wading.

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Daily gage height, in feet, of Little Wind River above Arapahoe, Wyo., for 1907 and 1908.

[Charles H. Kealear, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	0.70	0.65	0.68	.....	.....	.....	1.50	1.00	0.92
2	.72	.65	.60	.....	.....	.....	1.40	1.00	.90
3	.70	.65	.70	.....	.....	.....	1.40	1.00	.92
4	.75	.65	.70	.....	.....	.....	1.35	1.00	.98
5	.75	.70	.70	.....	.....	.....	1.30	1.00	1.00
6	.78	.70	.70	.....	.....	.....	1.20	1.00	.92
7	.80	.70	.70	.....	.....	.....	1.25	1.00	.90
8	.70	.68	.70	.....	.....	.....	1.20	1.00	.90
9	.65	.70	.70	.....	.....	2.30	1.20	1.00	.90
10	.75	.70	.78	.....	.....	2.40	1.20	.95	.82
11	.65	.80	.80	.....	.....	2.25	1.20	.90	.80
12	.68	.82	1.10	.....	.....	2.10	1.20	.90	.90
13	.65	.80	1.25	.....	.....	1.90	1.10	.80	.....
14	.60	.80	1.10	.....	.....	1.80	1.00	.80	.....
15	.60	.92	1.05	.....	.....	1.70	1.00	.80	.....
16	.60	.98	1.05	.....	.....	1.70	1.00	.80	.....
17	.60	.95	1.25	.....	.....	1.70	1.00	.90	.....
18	.60	.90	1.50	.....	.....	1.65	1.00	.90	.....
19	.65	.80	1.55	.....	.....	1.70	1.00	.90	.....
20	.70	.80	1.50	.....	.....	1.75	1.00	.90	.....
21	.90	.80	.....	.....	.....	1.70	1.00	.90	.....
22	.85	.72	.....	.....	.....	1.60	1.00	.90	.....
23	.80	.80	.....	.....	.....	1.50	1.00	.90	.....
24	.75	.80	.....	.....	.....	1.50	.95	.90	.....
25	.70	.80	.....	.....	.....	1.40	.90	.90	.....
26	.70	.78	.....	.....	.....	1.55	.90	.90	.....
27	.70	.78	.....	.....	.....	1.70	.90	.98	.....
28	.60	.75	.....	.....	.....	1.65	.90	1.00	.....
29	.58	.72	.....	.....	.....	1.60	1.00	1.00	.....
30	.60	.68	.....	.....	.....	1.50	1.00	1.00	.....
31	.65	.....	.....	.....	.....	1.50	.....	1.00	.....
1908.									
1	.....	.8	1.1	1.6	2.85	1.8	1.3	.....	1.1
2	.....	.75	1.1	1.5	2.9	1.75	1.3	.....	1.1
3	.....	.75	1.1	1.4	2.9	1.65	1.3	.....	1.1
4	.....	.75	1.15	1.4	3.15	1.6	1.3	.....	1.1
5	.....	.8	1.25	1.4	3.4	1.6	1.2	.....	1.1
6	.....	.75	1.25	1.35	3.55	1.6	1.15	.....	1.1
7	.....	.8	1.35	1.3	3.15	1.8	1.05	.....	1.1
8	.....	.8	1.55	1.6	2.95	1.8	1.05	.....	1.1
9	.....	.8	1.85	1.65	2.85	1.7	1.05	.....	.....
10	.....	.7	1.9	1.85	2.85	1.65	1.1	.....	.....
11	.....	.7	1.65	2.2	2.85	1.8	1.1	.....	.....
12	.....	.8	1.5	2.75	2.75	1.9	1.1	.....	.....
13	.....	.8	1.5	2.9	2.7	1.8	1.1	.....	.....
14	.....	.9	1.6	3.3	2.6	1.95	1.1	.....	.....
15	1.65	1.0	1.55	3.45	2.6	2.15	1.1	.....	.....
16	1.7	1.1	1.55	3.55	2.5	2.1	1.1	.....	.....
17	1.5	1.0	1.4	3.25	2.55	2.0	1.1	.....	.....
18	1.45	1.0	1.3	3.25	2.45	1.85	1.1	.....	.....
19	1.2	1.1	1.3	2.95	2.35	1.8	1.1	.....	.....
20	1.15	1.1	1.35	2.65	2.2	1.8	1.1	.....	.....
21	.95	1.25	1.4	2.35	2.1	1.8	1.1	.....	.....
22	1.15	1.35	1.4	2.4	2.0	2.15	1.1	.....	.....
23	.9	1.3	1.4	2.45	2.0	2.25	1.1	.....	.....
24	.9	1.3	1.65	2.25	2.05	2.05	1.1	.....	.....
25	.85	1.25	1.55	2.55	2.0	2.95	1.1	.....	.....
26	.85	1.2	1.6	2.85	2.0	1.8	1.2	.....	.....
27	.85	1.1	1.55	3.2	2.0	1.65	1.2	.....	.....
28	.75	1.1	1.5	3.1	2.0	1.45	1.2	.....	.....
29	.65	1.1	1.5	2.85	2.0	1.4	1.1	.....	.....
30	.8	1.1	1.5	2.7	1.9	1.4	1.1	.....	.....
31	.75	.....	1.5	.....	1.85	1.4	.....	.....	.....

NOTE.—Ice periods, January 1 to about March 13, 1907, probably November 13, 1907 to March 27, 1908, and after November 8, 1908. Probable backwater effect due to ice during first part of March, 1907 and March 15-22, 1908.

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Rating tables for Little Wind River above Arapahoe, Wyo.

JANUARY 1 TO MAY 20, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	50	0.80	125	1.10	230	1.40	365
.60	72	.90	157	1.20	270	1.50	420
.70	97	1.00	192	1.30	315	1.60	480

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is a portion of the rating table published for this station in the 1906 report. It is not well defined.

AUGUST 1, 1907, TO JUNE 10, 1908.

0.60	30	1.10	175	1.60	416	2.10	738
.70	55	1.20	215	1.70	475	2.20	810
.80	80	1.30	260	1.80	536	2.30	884
.90	110	1.40	310	1.90	601	2.40	960
1.00	140	1.50	360	2.00	668		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during 1907 and the form of the 1908 curve. It is well defined above gage heights 0.9 foot.

JUNE 11 TO SEPTEMBER 30, 1908.

0.70	40	1.50	300	2.30	788	3.10	1,354
.80	62	1.60	350	2.40	856	3.20	1,429
.90	87	1.70	404	2.50	925	3.30	1,505
1.00	115	1.80	461	2.60	994	3.40	1,582
1.10	145	1.90	521	2.70	1,064	3.50	1,660
1.20	178	2.00	585	2.80	1,135	3.60	1,740
1.30	215	2.10	652	2.90	1,207		
1.40	255	2.20	720	3.00	1,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during 1908, and is fairly well defined between gage heights 1 foot and 3.5 feet.

Monthly discharge of Little Wind River above Arapahoe, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March	157	.....	83.0	5,100	C.
April	185	84	117	6,960	B.
May 1–20	450	72	192	7,620	B.
August 9–31	960	310	512	23,400	A.
September	360	110	182	10,800	A.
October	140	80	120	7,380	A.
November 1–12	140	80	112	2,670	C.
1908.					
April	285	55	140	8,330	B.
May	601	175	339	20,800	A.
June	1,700	260	907	54,000	B.
July	1,700	491	943	58,000	A.
August	1,240	255	484	29,800	A.
September	215	130	158	9,400	B.
The period	.....	.....	.....	180,000	

NOTE.—On October 21, 1907, the Indian ditch was diverting about 5 second-feet.

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LITTLE WIND RIVER BELOW ARAPAHOE, WYO.

This station, which was established May 11, 1906, to obtain data for use in general studies of run-off, is located at the government bridge, 200 yards below the mouth of Popo Agie River, one-half mile south of the post-office at Arapahoe, and about 6 miles above the junction of Little Wind and Big Wind rivers. Beaver Creek enters from the south between the station and the mouth of the river. The drainage area of Little Wind River at its mouth is about 1,900 square miles.

The records at this station show practically the entire flow of Little Wind River except a small amount of water used for irrigation.

Many diversions are made for irrigation from Little Wind and Popo Agie rivers above this station, but opportunities for additional development both for power and irrigation yet remain.

The location of the rod gage has remained unchanged since the establishment of the station, but the bridge was raised 0.17 foot at the gage when the ice went out in the spring of 1908, and all the gage readings for 1908 are low by that amount. They have not been corrected to the old datum.

Conditions at this station are not favorable for accurate results because of the eddies around the pile bents at all stages and the sluggishness of the current at low water. The stream is icebound for several months during the winter season.

Discharge measurements of Little Wind River below Arapahoe, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 25	W. B. Freeman	96	441	2.46	606
October 21	do	93	356	1.60	237
1908.					
June 15	W. B. Freeman	104	857	5.75	4,120
July 25	J. B. Stewart	97.3	521	2.98	1,050
August 26	do	97.8	481	2.60	830
November 5	W. B. Freeman	92.5	336	1.68	290
Do	do			1.68	[a]346
December 26 [b]	R. L. Cooper	95	363	2.00	300

[a] Combined discharges of Little Wind River (discharge 142 second-feet) and Popo Agie River (discharge 204 second-feet) above their junction. These measurements were made by wading and give the combined discharge more accurately than the other measurement of November 5, which was made below the junction and at a poor measuring section.

[b] Ice conditions.

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Daily gage height, in feet, of Little Wind River below Arapahoe, Wyo., for 1907 and 1908.

[Charles H. Kealear, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	.....	1.50	1.78	.....	.....	.....	2.48	1.85	1.68
2	.....	1.50	1.80	.....	.....	.....	2.40	1.80	1.60
3	.....	1.60	1.82	.....	.....	.....	2.32	1.85	1.60
4	.....	1.62	1.80	.....	.....	.....	2.30	1.90	1.70
5	.....	1.70	1.80	.....	.....	.....	2.30	1.90	1.70
6	.....	1.70	1.75	.....	.....	.....	2.30	1.90	1.65
7	.....	1.65	1.70	.....	.....	.....	2.32	1.80	1.60
8	1.75	1.62	1.70	.....	.....	.....	2.30	1.80	1.60
9	1.65	1.60	1.80	.....	.....	3.60	2.25	1.80	1.60
10	1.65	1.65	1.85	.....	.....	3.50	2.20	1.80	1.68
11	1.60	1.85	2.12	.....	.....	3.25	2.20	1.70	1.62
12	1.50	2.00	2.62	.....	.....	3.00	2.10	1.70	1.60
13	1.15	1.90	2.85	.....	.....	2.95	2.10	1.70	.....
14	1.20	2.05	2.62	.....	.....	2.82	2.00	1.70	.....
15	1.15	2.25	2.60	.....	.....	2.75	2.00	1.70	.....
16	1.35	2.32	2.72	.....	.....	2.82	1.90	1.70	.....
17	1.30	2.30	2.90	.....	.....	2.72	1.85	1.70	.....
18	1.30	2.22	3.40	.....	.....	2.68	1.80	1.60	.....
19	1.65	2.10	3.65	.....	.....	2.85	1.80	1.60	.....
20	1.80	2.00	3.90	.....	.....	2.82	1.80	1.60	.....
21	2.22	2.00	.....	.....	.....	2.65	1.80	1.60	.....
22	1.58	1.90	.....	.....	.....	2.60	1.78	1.60	.....
23	1.90	1.95	.....	.....	.....	2.50	1.72	1.60	.....
24	1.68	2.00	.....	.....	.....	2.45	1.70	1.60	.....
25	1.70	2.00	.....	.....	.....	2.42	1.70	1.60	.....
26	1.68	2.00	.....	.....	.....	2.70	1.70	1.60	.....
27	1.60	1.95	.....	.....	.....	2.80	1.60	1.70	.....
28	1.48	1.90	.....	.....	.....	2.70	1.70	1.70	.....
29	1.50	1.90	.....	.....	.....	2.62	1.75	1.70	.....
30	1.48	1.82	.....	.....	.....	2.52	1.90	1.70	.....
31	1.45	.....	.....	.....	.....	2.62	.....	1.70	.....
1908.									
1	.....	1.1	2.0	3.05	4.4	2.6	2.0	.....	1.75
2	.....	.95	2.05	2.9	4.35	2.5	1.9	.....	1.7
3	.....	1.1	2.1	2.8	4.3	2.5	1.8	.....	1.7
4	.....	1.0	2.2	2.8	4.65	2.4	1.75	.....	1.7
5	.....	1.1	2.3	2.75	5.15	2.35	1.7	.....	1.7
6	.....	1.1	2.3	2.65	5.15	2.3	1.6	.....	1.7
7	.....	1.1	2.5	2.6	4.65	2.5	1.6	.....	1.7
8	.....	1.2	2.85	2.9	4.35	2.4	1.55	.....	1.6
9	.....	1.2	3.25	3.05	4.25	2.3	1.6	.....	.....
10	.....	1.1	3.25	3.45	4.15	2.35	1.6	.....	.....
11	.....	1.1	2.9	3.95	4.25	2.45	1.6	.....	.....
12	.....	1.2	2.65	4.7	4.35	2.7	1.6	.....	.....
13	.....	1.3	2.65	4.95	4.2	2.8	1.7	.....	.....
14	.....	1.5	2.75	5.4	4.0	3.15	1.7	.....	.....
15	2.8	1.7	2.65	5.6	4.0	3.15	1.7	.....	.....
16	2.8	1.8	2.65	5.7	3.9	3.1	1.7	.....	.....
17	2.8	1.8	2.5	5.4	3.85	2.85	1.65	.....	.....
18	2.7	1.95	2.4	5.6	3.6	2.7	1.6	.....	.....
19	2.7	2.2	2.35	4.7	3.3	2.7	1.6	.....	.....
20	2.6	2.25	2.55	4.2	3.05	2.7	1.6	.....	.....
21	2.45	2.45	2.55	3.75	3.0	2.8	1.55	.....	.....
22	2.5	2.6	2.6	4.1	2.95	3.4	1.5	.....	.....
23	2.4	2.6	2.75	4.05	2.95	3.35	1.4	.....	.....
24	2.3	2.5	3.0	3.85	3.05	3.1	1.75	.....	.....
25	2.35	2.45	2.85	4.25	3.0	2.85	2.0	.....	.....
26	1.7	2.2	3.05	4.7	2.9	2.7	2.0	.....	.....
27	1.5	2.1	2.95	5.05	2.9	2.55	1.95	.....	.....
28	.85	2.05	2.9	4.75	2.8	2.35	1.9	.....	.....
29	1.0	2.1	2.95	4.45	2.8	2.15	1.8	.....	.....
30	.95	2.0	3.0	4.3	2.7	2.0	1.65	.....	.....
3	1.05	.....	3.0	.....	2.7	2.0	.....	1.8	.....

s January 1 to about March 12, 1907, and probably from November 12, 1907, to
r November 9, 1908.

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Rating tables for Little Wind River below Arapahoe, Wyo.

FOR 1906 TO 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	125	1.90	360	2.70	805	3.50	1,430
1.20	150	2.00	405	2.80	875	3.60	1,520
1.30	175	2.10	450	2.90	945	3.70	1,615
1.40	200	2.20	500	3.00	1,020	3.80	1,710
1.50	225	2.30	555	3.10	1,095	3.90	1,810
1.60	255	2.40	615	3.20	1,175		
1.70	285	2.50	675	3.30	1,255		
1.80	320	2.60	740	3.40	1,340		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 23 discharge measurements made during 1906 and 1907, and is well defined.

FOR 1908.

0.80	100	1.90	445	3.00	1,150	4.20	2,300
.90	120	2.00	490	3.10	1,235	4.40	2,535
1.00	140	2.10	540	3.20	1,320	4.60	2,790
1.10	165	2.20	595	3.30	1,410	4.80	3,050
1.20	190	2.30	655	3.40	1,500	5.00	3,320
1.30	220	2.40	720	3.50	1,590	5.20	3,595
1.40	255	2.50	785	3.60	1,690	5.40	3,875
1.50	290	2.60	850	3.70	1,790	5.60	4,165
1.60	325	2.70	920	3.80	1,890	5.80	4,460
1.70	360	2.80	995	3.90	1,990	6.00	4,760
1.80	400	2.90	1,070	4.00	2,090		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1908 and the form of the 1907 curve, and is fairly well defined. The difference between the 1907 and 1908 ratings is due to a change in gage datum and not because of shifting-channel conditions.

Monthly discharge of Little Wind River below Arapahoe, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
March 8–31	511	.....	220	10,100	C.
April	567	225	364	21,700	A.
May 1–20	1,810	285	661	26,200	A.
August 9–31	1,520	627	884	40,300	A.
September	663	255	417	24,800	A.
October	360	255	293	18,000	A.
November 1–12	285	255	266	6,330	C.
1908.					
April	850	130	401	23,900	B.
May	1,360	490	908	55,800	B.
June	4,310	850	2,310	137,000	B.
July	3,520	920	1,890	116,000	B.
August	1,500	490	896	55,100	B.
September	490	255	365	21,700	C.
November 1–8	380	325	358	5,680	C.
The period	.....	.....	.....	415,000	

NOTE.—Discharge estimated March 8–12, 1907.

LITTLE POPO AGIE RIVER AT HUDSON, WYO.

This station, which was established August 26, 1907, to determine the amount of unused water in the stream available for additional irrigation and storage, is located at the highway bridge three-eighths of a mile southwest of the post-office at Hudson, Wyo., and a few

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hundred yards above the mouth of the stream. The station is below all the tributaries of the Little Popo Agie. The drainage area is about 360 square miles.

For 20 miles or more above this station small ditches take out water to irrigate the valley lands along the stream.

The present chain gage, which was established on June 13, 1908, is located 100 yards downstream from the bridge and the old rod gage. It was set at a different datum from the old gage, but the reading was the same as the reading of the old gage at the time it was located.

High-water measurements were taken from the bridge, but the location is not specially good. There is a bend in the stream a short distance above, the right bank is subject to overflow at high stages, and the bridge itself is sometimes overflowed at extreme stages. However, the results obtained here have been very satisfactory. The flow is affected by ice for several months during the winter season.

Discharge measurements of Little Popo Agie River at Hudson, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				Old gage.	New gage.	
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
August 26	W. B. Freeman	34	55	2.50	.....	72
October 20	do	33	48	2.30	.....	44
1908.						
June 13	W. B. Freeman	33.5	151	5.25	5.33	662
June 14	do	33.5	103	3.90	4.05	341
June 15	do	33.5	109	4.00	4.18	357
July 26	J. B. Stewart	35	60	2.70	2.80	96
August 25	do	35	55	.....	2.62	74
November 5	W. B. Freeman	33.5	51	2.47	2.48	61

Daily gage height, in feet, of Little Popo Agie River at Hudson, Wyo., for 1907 and 1908.

[O. S. Riggs, observer.]

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]						1907.					
1	.....	2.50	2.35	2.30	2.20	16	.....	2.30	2.25	2.22	2.25
2	.....	2.50	2.35	2.30	2.20	17	.....	2.30	2.30	2.32	2.30
3	.....	2.48	2.40	2.30	2.10	18	.....	2.30	2.30	2.30	2.25
4	.....	2.45	2.40	2.30	2.20	19	.....	2.30	2.30	2.22	2.32
5	.....	2.45	2.38	2.30	2.20	20	.....	2.30	2.30	2.30	2.35
6	.....	2.45	2.35	2.30	2.20	21	.....	2.30	2.30	2.35	2.40
7	.....	2.45	2.35	2.30	2.20	22	.....	2.30	2.30	2.20	2.55
8	.....	2.45	2.35	2.30	2.20	23	.....	2.30	2.30	2.20	2.60
9	.....	2.40	2.35	2.30	2.15	24	.....	2.30	2.30	2.20	2.60
10	.....	2.40	2.35	2.30	2.10	25	.....	2.28	2.30	2.32	.....
11	.....	2.35	2.32	2.15	2.30	26	2.50	2.25	2.35	.....	.....
12	.....	2.35	2.25	2.25	2.35	27	2.52	2.25	2.35	2.22	.....
13	.....	2.32	2.25	2.25	2.35	28	2.50	2.30	2.35	2.25	.....
14	.....	2.30	2.25	2.22	2.30	29	2.50	2.30	2.35	2.20	.....
15	.....	2.30	2.25	2.22	2.15	30	2.50	2.35	2.30	2.20	.....
						31	2.50	.....	2.30	.....	.....

[a] Gage heights affected by ice December 11–24, 1907.

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Daily gage height, in feet, of Little Popo Agie River at Hudson, Wyo., for 1907 and 1908—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.[a]								
1	2.2	2.6	3.2	3.6	2.6	2.4	2.6	2.55
2	2.2	2.6	3.2	3.7	2.6	2.4	2.5	2.5
3	2.2	2.6	3.15	3.55	2.6	2.35	2.9	2.55
4	2.2	2.7	3.1	3.65	2.6	2.3	2.8	2.55
5	2.2	2.7	3.1	3.85	2.5	2.3	2.8	2.5
6	2.25	2.7	3.05	3.95	2.5	2.3	2.8	2.5
7	2.3	2.75	3.05	3.7	2.5	2.3	2.6	2.5
8	2.2	2.8	3.2	3.6	2.5	2.3	2.6	2.5
9	2.3	3.0	3.4	3.5	2.5	2.3	2.6	2.5
10	2.3	3.0	3.6	3.4	2.5	2.3	2.6	2.4
11	2.3	2.8	3.5	3.45	2.5	2.3	2.6	.....
12	2.35	2.75	3.6	3.65	2.7	.....	2.6	.....
13	2.4	2.7	4.7	3.6	2.6	2.3	2.6	.....
14	2.5	2.8	4.25	3.5	2.8	2.3	2.6	.....
15	2.45	2.85	4.35	3.4	3.9	2.3	2.55	.....
16	2.55	2.8	4.6	3.3	2.9	2.3	2.6	.....
17	2.55	2.75	4.35	3.25	2.7	2.3	2.6	.....
18	2.6	2.75	5.65	3.1	2.65	2.3	2.6	.....
19	2.6	2.8	4.05	3.1	2.65	2.3	2.6	.....
20	2.65	3.0	3.8	3.0	2.7	2.3	2.6	.....
21	2.7	2.95	3.6	2.9	2.7	2.3	2.6	.....
22	2.75	2.95	3.7	2.9	2.8	2.3	2.55	.....
23	2.75	3.15	3.75	2.9	2.75	2.3	2.55	.....
24	2.7	3.25	3.6	2.8	2.7	2.3	2.55	.....
25	2.7	3.1	3.65	2.8	2.6	2.4	2.55	.....
26	2.6	3.1	3.8	2.8	2.6	2.6	2.6	.....
27	2.5	3.15	4.0	2.8	2.5	2.6	2.6	.....
28	2.55	3.15	3.8	2.75	2.5	2.55	2.55	.....
29	2.6	3.25	3.6	2.8	2.4	2.55	2.55	.....
30	2.6	3.3	3.5	2.7	2.4	2.6	2.6	.....
31	.....	3.25	.....	2.7	2.4	.....	2.55	.....

[a] Ice conditions December 11, 1907, to about February 29, 1908, and after November 11, 1908.

Rating tables for Little Popo Agie River at Hudson, Wyo.

AUGUST 26, 1907, TO JUNE 13 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	27	2.80	117	3.50	270	4.20	420
2.20	35	2.90	135	3.60	282	4.30	443
2.30	45	3.00	154	3.70	305	4.40	466
2.40	56	3.10	174	3.80	328	4.50	489
2.50	70	3.20	195	3.90	351	4.60	512
2.60	85	3.30	216	4.00	374	4.70	535
2.70	100	3.40	238	4.10	397		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1907–8 and is well defined between gage heights 2.3 feet and 5.0 feet.

JUNE 14 TO NOVEMBER 10, 1908.

2.30	44	3.20	167	4.10	300	5.00	577
2.40	53	3.30	187	4.20	383	5.10	602
2.50	63	3.40	207	4.30	406	5.20	628
2.60	73	3.50	227	4.40	429	5.30	654
2.70	84	3.60	248	4.50	453	5.40	681
2.80	97	3.70	270	4.60	477	5.50	708
2.90	111	3.80	292	4.70	502	5.60	735
3.00	128	3.90	314	4.80	527	5.70	763
3.10	147	4.00	337	4.90	552		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1907–8 and is well defined between gage heights 2.4 feet and 5.3 feet.

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Monthly discharge of Little Popo Agie River at Hudson, Wyo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
August 26–31	73	70	70.5	839	A.
September	70	40	51.3	3,050	A.
October	56	40	47.0	2,890	A.
November	50	31	41.2	2,450	B.
December 1–24	35	25	28.3	1,350	D.
1908.					
April	108	35	66.9	3,980	A.
May	216	85	138	8,480	A.
June	749	164	296	17,600	A.
July	326	84	181	11,100	A.
August	314	53	81.4	5,010	A.
September	73	44	49.5	2,950	B.
October	111	63	74.9	4,610	A.
November 1–10	68	53	63.5	1,260	A.
The period				55,000	

SHOSHONE RIVER AT CODY, WYO.

This station, which is located at the highway bridge 1 mile northeast of Cody, Wyo., was established April 26, 1902, to obtain data to be used in connection with the Shoshone reclamation project.

The principal tributaries are the North and South forks, which unite 8 miles above Cody to form the Shoshone. The drainage area above the gaging station is 1,400 square miles, but the entire run-off from this area does not pass the station as a number of private irrigation canals divert water from the Shoshone and its branches above the station. These canals irrigate about 35,000 acres of land. Below Cody irrigation has been carried on quite extensively by means of private canal systems that serve about 45,000 acres.

The conditions for obtaining accurate discharge data are good. Ice does not affect the flow at this station, as the river is kept open by springs which enter the river a short distance above the gage. The gage datum has remained unchanged.

Discharge measurements of Shoshone River at Cody, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. feet.*	*Feet.*	*Sec.-ft.*
April 18	G. F. Harley	134	393	3.11	1,120
April 20	do	126	363	2.83	895
May 20	do	180	752	5.30	4,700
June 24	Downey and Blakeslee	179	813	5.40	5,140
June 27	G. L. Blakeslee	178	798	5.50	5,250
July 3	Ahern and Craig	196	1,170	6.80	9,930
July 23	P. S. Craig	196	1,070	6.10	7,250
October 11	J. Ahern	118	331	2.70	537
December 4	do	118	240	2.20	298
1908.					
April 15	G. L. Blakeslee	148	430	3.80	1,720
April 18	Blakeslee and Downey	152	488	3.75	1,840
April 21	A. C. Downey	158	576	4.45	3,010
April 24	G. L. Blakeslee	145	465	3.70	1,670
April 28	do	138	398	3.15	930
May 9	do	163	594	4.45	2,900
May 16	do	148	453	3.60	1,400
Do	do	148	453	3.60	1,420
June 12	do	195	876	6.00	6,860
October 16	J. E. Stewart	148	468	3.68	1,360

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Daily gage height, in feet, of Shoshone River at Cody, Wyo., for 1907 and 1908.

[S. C. Bovard, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.8	1.95	1.95	2.5	2.7	4.35	6.5	5.4	3.6	3.0	2.5	2.5
2	1.8	1.9	1.95	2.65	2.7	5.55	7.0	5.2	3.6	3.0	2.45	2.4
3	1.7	1.7	1.85	2.65	2.65	5.2	7.1	5.2	3.5	3.0	2.45	2.4
4	1.65	1.6	1.9	2.6	2.7	5.1	8.0	5.5	3.5	3.0	2.45	2.35
5	1.95	1.65	1.85	2.7	2.75	5.4	7.5	5.0	3.5	3.0	2.35	2.3
6	1.9	1.85	2.05	2.55	2.9	5.6	6.9	4.9	3.5	3.0	2.35	2.7
7	1.9	1.95	2.1	2.5	2.9	5.95	7.1	5.0	3.5	3.0	2.35	2.45
8	1.85	1.95	2.0	2.4	2.9	5.8	6.8	4.9	3.5	3.0	2.4	2.4
9	1.8	1.95	2.0	2.5	3.2	5.5	7.0	4.9	3.5	3.0	2.35	2.35
10	1.7	1.9	2.0	2.8	3.65	5.0	6.8	4.8	3.4	2.9	2.35	2.3
11	1.8	1.9	2.0	3.15	4.0	5.2	6.8	4.3	3.4	2.9	2.2	2.3
12	1.85	1.9	1.95	3.05	4.4	5.5	6.5	4.1	3.4	2.85	2.05	2.45
13	1.7	2.0	1.9	3.1	3.9	5.5	6.5	4.1	3.4	2.85	2.2	2.4
14	1.7	2.0	1.85	3.35	3.8	5.0	6.4	4.1	3.4	2.85	2.2	2.35
15	1.65	2.0	1.9	3.5	3.6	5.0	6.2	4.3	3.4	2.85	2.4	2.2
16	1.7	2.0	1.95	3.4	4.3	4.8	5.4	4.1	3.3	2.8	2.5	2.2
17	1.75	2.0	2.0	3.45	4.8	4.6	5.4	4.0	3.3	2.8	2.5	2.3
18	1.8	2.0	2.0	3.1	5.0	5.4	5.4	4.0	3.2	2.8	2.5	2.25
19	1.9	2.1	2.95	3.0	5.5	5.7	6.0	4.0	3.1	2.65	2.45	2.0
20	1.9	2.1	3.15	2.9	5.6	6.2	6.2	3.95	3.1	2.65	2.4	2.0
21	1.8	2.05	3.0	2.8	5.5	6.1	6.2	3.7	3.05	2.65	2.4	2.0
22	1.9	2.1	2.8	2.9	5.2	6.2	6.0	3.7	3.05	2.65	2.4	2.0
23	2.0	2.1	2.55	3.0	5.3	6.0	6.1	3.7	3.0	2.6	2.4	2.1
24	1.9	2.15	2.5	3.1	5.3	5.5	6.0	3.7	3.0	2.6	2.4	2.1
25	1.85	2.0	2.45	2.9	4.5	5.5	6.0	3.8	3.0	2.6	2.4	2.25
26	1.85	2.0	2.3	2.9	4.3	5.2	5.8	3.7	3.0	2.6	2.5	2.4
27	1.8	1.9	2.1	2.75	4.0	5.6	5.6	3.8	3.0	2.6	2.5	2.4
28	1.8	1.9	2.2	2.7	3.9	6.4	5.5	3.8	3.0	2.6	2.5	2.4
29	1.9	.....	2.25	2.65	3.9	6.6	5.6	3.7	3.0	2.6	2.4	2.4
30	1.9	.....	2.2	2.7	4.0	6.6	5.6	3.7	3.0	2.5	2.5	2.4
31	1.9	.....	2.4	.....	4.1	.....	5.6	3.8	.....	2.5	.....	2.4
1908.												
1	2.35	2.2	2.1	2.1	3.25	5.3	6.3	4.9	3.5	3.0	2.9	2.4
2	2.35	2.1	2.1	2.1	3.7	4.7	6.2	4.7	3.3	2.9	3.0	2.4
3	2.35	2.1	2.1	2.2	4.0	4.5	6.4	4.7	3.25	3.0	3.0	2.4
4	2.25	2.1	2.1	2.5	3.85	4.5	6.9	4.5	3.2	3.0	3.0	2.4
5	2.2	2.1	2.1	2.4	3.7	4.3	6.6	4.4	3.25	3.1	3.0	2.3
6	2.2	2.1	2.0	2.4	4.0	4.25	6.0	4.3	3.25	3.2	3.0	2.3
7	2.2	2.1	2.0	2.3	4.45	4.55	6.1	4.3	3.25	3.2	3.0	2.3
8	2.4	2.1	2.0	2.2	4.6	4.75	6.1	4.2	3.2	3.45	3.0	2.35
9	2.4	2.1	2.1	2.3	4.4	5.0	6.9	4.2	3.2	3.4	2.9	2.35
10	2.4	2.1	2.1	2.75	4.3	5.2	6.7	4.1	3.1	3.3	2.9	2.35
11	2.4	2.1	2.1	3.05	3.95	5.7	6.4	4.3	3.1	3.25	2.9	2.35
12	2.35	2.1	2.2	3.3	3.7	6.05	6.3	4.15	3.1	3.2	2.7	2.35
13	2.4	2.1	2.2	3.6	3.6	6.0	6.3	3.9	3.1	3.0	2.7	2.35
14	2.4	2.1	2.2	3.8	3.7	6.4	6.5	4.0	3.4	3.0	2.7	2.35
15	2.4	2.1	2.3	3.8	3.6	6.7	6.2	4.5	3.2	3.4	2.7	2.35
16	2.35	2.1	2.4	3.7	3.5	6.4	6.1	3.9	3.2	3.6	2.7	2.25
17	2.4	2.1	2.9	3.8	3.55	6.5	5.9	3.9	3.1	3.25	2.7	2.25
18	2.4	2.1	2.5	3.8	3.45	6.0	5.6	3.8	3.3	3.2	2.7	2.25
19	2.4	2.1	2.4	4.1	3.4	5.5	5.5	4.95	3.2	3.2	2.7	2.2
20	2.4	2.1	2.1	4.35	3.8	5.2	5.6	4.5	3.1	3.1	2.7	2.2
21	2.35	2.1	2.1	4.05	3.7	5.15	5.5	4.1	3.0	2.9	2.7	2.2
22	2.4	2.1	2.1	4.3	4.0	5.0	5.4	4.1	3.0	2.9	2.7	2.2
23	2.35	2.1	2.1	4.0	3.75	4.8	5.4	4.1	2.9	2.9	2.7	2.2
24	2.4	2.2	2.1	3.7	3.9	5.0	5.3	4.1	3.0	2.9	2.5	2.2
25	2.2	2.2	2.1	3.5	3.9	5.6	5.2	3.9	3.0	2.9	2.4	2.2
26	2.2	2.2	2.15	3.3	4.0	6.1	5.1	3.8	3.0	2.9	2.4	2.2
27	2.2	2.1	2.1	3.2	3.95	6.7	5.1	3.7	3.0	2.9	2.4	2.2
28	2.25	2.2	2.1	3.15	4.05	5.6	5.1	3.7	3.0	2.9	2.4	2.2
29	2.2	2.2	2.1	3.15	4.1	5.5	5.4	3.7	3.0	2.9	2.4	2.2
30	2.2	.....	2.1	3.2	4.1	5.4	5.0	3.6	3.0	2.9	2.4	2.2
31	2.2	.....	2.1	.....	4.9	.....	4.9	3.6	.....	2.9	.....	2.2

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Rating tables for Shoshone River at Cody, Wyo.

JANUARY 1 TO JULY 25, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	160	2.90	930	4.20	2,520	6.00	6,930
1.70	190	3.00	1,020	4.30	2,680	6.20	7,620
1.80	225	3.10	1,110	4.40	2,850	6.40	8,350
1.90	265	3.20	1,210	4.50	3,030	6.60	9,150
2.00	310	3.30	1,310	4.60	3,220	6.80	10,000
2.10	360	3.40	1,420	4.70	3,420	7.00	10,900
2.20	415	3.50	1,540	4.80	3,630	7.20	11,800
2.30	475	3.60	1,660	4.90	3,850	7.40	12,800
2.40	540	3.70	1,790	5.00	4,080	7.60	13,800
2.50	610	3.80	1,920	5.20	4,570	7.80	14,800
2.60	685	3.90	2,060	5.40	5,100	8.00	15,800
2.70	765	4.00	2,210	5.60	5,670		
2.80	845	4.10	2,360	5.80	6,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during this period and the general form of previous curves at low stages and is well defined.

JULY 26 TO DECEMBER 31, 1907.

2.00	195	2.90	725	3.80	1,780	4.70	3,320
2.10	230	3.00	820	3.90	1,930	4.80	3,530
2.20	270	3.10	920	4.00	2,080	4.90	3,750
2.30	315	3.20	1,030	4.10	2,240	5.00	3,980
2.40	365	3.30	1,140	4.20	2,400	5.20	4,580
2.50	425	3.40	1,260	4.30	2,570	5.40	5,140
2.60	490	3.50	1,380	4.40	2,750	5.60	5,750
2.70	560	3.60	1,510	4.50	2,930	5.80	6,380
2.80	640	3.70	1,640	4.60	3,120		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during this period and the form of the subsequent curve and is fairly well defined.

JANUARY 1 TO JULY 31, 1908.

2.00	180	3.10	890	4.20	2,430	5.60	5,660
2.10	210	3.20	1,000	4.30	2,610	5.80	6,270
2.20	250	3.30	1,110	4.40	2,800	6.00	6,930
2.30	300	3.40	1,230	4.50	3,000	6.20	7,620
2.40	350	3.50	1,360	4.60	3,200	6.40	8,350
2.50	410	3.60	1,490	4.70	3,410	6.60	9,150
2.60	475	3.70	1,630	4.80	3,620	6.80	10,000
2.70	545	3.80	1,780	4.90	3,840	7.00	10,900
2.80	620	3.90	1,930	5.00	4,070		
2.90	700	4.00	2,090	5.20	4,560		
3.00	790	4.10	2,260	5.40	5,090		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seventeen discharge measurements made during 1907–8 and is well defined.

AUGUST 1 TO DECEMBER 31, 1908.

2.20	190	3.00	620	3.80	1,540	4.60	3,070
2.30	225	3.10	700	3.90	1,700	4.70	3,300
2.40	265	3.20	790	4.00	1,870	4.80	3,530
2.50	310	3.30	890	4.10	2,050	4.90	3,770
2.60	360	3.40	1,000	4.20	2,240	5.00	4,010
2.70	420	3.50	1,120	4.30	2,440		
2.80	480	3.60	1,250	4.40	2,640		
2.90	550	3.70	1,390	4.50	2,850		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the general form of the previous curve and is not well defined.

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A. BOX CANYON IMMEDIATELY BELOW SHOSHONE DAM SITE, SHOSHONE RIVER WYOMING.

B. CORBETT TUNNEL, CORBETT DIVERSION DAM, SHOSHONE PROJECT, WYOMING.

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Monthly discharge of Shoshone River at Cody, Wyo., for 1907 and 1908.

[Drainage area, 1,690 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	310	175	234	0.138	0.18	14,400	A.
February	387	160	291	.197	.21	16,200	A.
March	1,160	245	442	.299	.34	27,200	A.
April	1,540	540	936	.626	.70	55,100	A.
May	5,670	725	2,520	1.70	1.96	155,000	A.
June	9,150	2,760	5,630	3.80	4.24	335,000	A.
July	15,800	5,100	8,280	5.59	6.44	509,000	A.
August	5,440	1,640	2,690	1.82	2.10	165,000	A.
September	1,510	820	1,120	.757	.84	66,600	A.
October	820	425	641	.433	.50	39,400	B.
November	425	212	366	.247	.28	21,800	B.
December	560	195	325	220	.25	20,000	B.
The year	15,800	160	1,060	1.32	18.04	1,420,000	
1908.							
January	350	250	310	.209	.24	19,100	A.
February	250	210	218	.147	.16	12,500	B.
March	700	180	246	.166	.19	15,100	A.
April	2,700	210	1,170	.791	.88	69,600	A.
May	3,840	1,060	1,970	1.33	1.53	121,000	A.
June	9,570	2,520	5,380	3.64	4.06	320,000	A.
July	10,400	3,840	6,680	4.51	5.20	411,000	A.
August	3,890	1,250	2,200	1.49	1.72	135,000	A.
September	1,120	550	744	.503	.56	44,300	B.
October	1,250	550	707	.478	.55	43,500	B.
November	620	265	449	.303	.34	26,700	C.
December	265	190	219	.148	.17	13,500	D.
The year	10,400	180	1,090	1.14	15.60	1,230,000	

SHOSHONE RIVER AT CORBETT DAM, WYO.

This station, which is located 8 miles below Cody, Wyo., at the Corbett diversion dam built by the United States Reclamation Service, was established April 20, 1908.

The dam is a reinforced concrete structure of the buttressed type, having on the upstream side a deck 2½ feet thick, sloping 1 to 1, and supported by buttresses 2 feet thick, spaced 14 feet on centers. It raises the low-water elevation of the river 10.2 feet. The length between abutments is 400 feet. (See Pl. IX, *B*.)

Sage Creek, the only important tributary that enters between this station and that at Cody, drains only about 25 square miles. During the irrigating season of 1908 about 75 second-feet were diverted above the dam through Corbett tunnel and used on the Shoshone reclamation project.

The gage is situated 40 feet above the crest of the dam, and it reads the height of the water above the crest.

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Daily gage height, in feet, of Shoshone River at Corbett dam, Wyo., for 1908.

[John A. Fleming, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.80	2.02	2.80	1.60	0.80	0.60	0.56
2	.....	1.02	1.60	2.90	1.65	.70	.60	.56
3	.....	1.28	1.62	3.10	1.60	.70	.60	.56
4	.....	1.00	1.70	3.35	1.40	.70	.65	.56
5	.....	1.00	1.50	3.45	1.30	.70	.70	.56
6	.....	1.22	1.45	2.50	1.35	.70	.70	.56
7	.....	1.52	1.60	2.40	1.30	.70	.70	.55
8	.....	1.72	1.65	2.90	1.25	.70	.81	.55
9	.....	1.58	2.00	3.00	1.20	.65	.73	.55
10	.....	1.45	2.20	3.10	1.15	.65	.70	.55
11	.....	1.22	2.55	2.80	1.30	.65	.68	.54
12	.....	1.08	2.75	2.75	1.15	.65	.66	.54
13	.....	1.12	2.75	2.80	1.00	.65	.65	.54
14	.....	1.00	3.00	3.00	1.10	.75	.65	.54
15	.....	.98	3.30	2.70	1.40	.70	.80	(a)
16	.....	.98	3.10	2.60	1.10	.65	.89	.....
17	.....	.92	3.10	2.50	1.05	.65	.77	.....
18	.....	.90	2.65	2.30	.95	.75	.68	.....
19	.....	.88	2.25	2.10	1.70	.65	.66	.....
20	1.50	1.18	2.00	2.20	1.40	.60	.63	.....
21	1.56	.92	2.00	2.20	1.20	.60	.60	.....
22	1.45	.92	1.95	2.10	1.20	.60	.60	.....
23	1.31	1.25	1.75	2.10	1.15	.55	.59	.....
24	1.10	1.02	1.80	1.95	1.15	.55	.63	.....
25	.95	1.20	2.20	1.90	1.10	.60	.61	.....
26	.90	1.35	2.65	1.90	1.00	.70	.60	.....
27	.82	1.25	3.00	1.80	.90	.65	.60	.....
28	.76	1.40	2.30	1.90	.85	.60	.63	.....
29	.72	1.25	2.10	1.95	.85	.70	.61	.....
30	.75	1.30	2.50	1.75	.85	.65	.60	.....
31	.....	1.72	.....	1.65	.90	.....	.58	.....

a Sluice gates open; no water flowing over dam.

Rating table for Shoshone River at Corbett dam, Wyo., for 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	420	1.30	1,980	2.10	4,090	2.90	6,770
.60	580	1.40	2,220	2.20	4,390	3.00	7,150
.70	750	1.50	2,465	2.30	4,700	3.10	7,550
.80	930	1.60	2,720	2.40	5,020	3.20	7,960
.90	1,120	1.70	2,980	2.50	5,350	3.30	8,380
1.00	1,320	1.80	3,245	2.60	5,690	3.40	8,810
1.10	1,530	1.90	3,520	2.70	6,040	3.50	9,240
1.20	1,750	2.00	3,800	2.80	6,400	3.60	9,680

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It was computed from data for weir model described in Water-Supply Paper 200, page 90.

Monthly discharge of Shoshone River at Corbett dam, Wyo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
April 20–30	2,620	786	1,520	33,200
May	3,030	930	1,720	106,000
June	8,380	2,340	4,630	276,000
July	9,020	2,850	5,360	330,000
	2,980	1,020	1,770	109,000
	930	500	689	41,000
	1,100	548	687	42,200
-14	516	484	502	13,900
riod	.....	.....	.....	951,000

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SOUTH FORK OF SHOSHONE RIVER AT MARQUETTE, WYO.

This station, which was established April 26, 1903, to determine the amount of water available for the Shoshone project of the United States Reclamation Service, is located at the highway bridge at Marquette, 12 miles west of Cody. It was discontinued during 1904, but was again established during 1905. On April 4, 1906, the station was moved 1¾ miles downstream to a point about one-half mile above the Shoshone dam. The station was discontinued September 30, 1908.

The drainage area is 500 square miles, but the entire run-off from this area does not pass the station, as about 10,000 acres of land are irrigated from this stream and all the water is diverted above the gaging station.

The conditions for obtaining accurate discharge data are good except during the winter months, when the gage heights are affected by ice.

Discharge measurements of South Fork of Shoshone River at Marquette, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of Section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 21	Downey and Blakeslee	144	464	4.20	3,070
June 25	G. L. Blakeslee	144	346	3.65	1,870
July 5	do	144	600	5.50	4,450
July 9	Downey and Russell	144	464	4.55	3,180
July 20	Blakeslee and Fraser	144	441	3.90	2,680
August 3	do	144	365	3.55	1,880
August 14	A. C. Downey	144	233	2.70	914
August 23	G. L. Blakeslee	138	188	2.20	639
August 29	Robert Follansbee	124	188	2.30	520
1908.					
April 20	A. C. Downey	144	292	2.75	1,130
Do	G. L. Blakeslee	144	306	2.75	1,100
April 29	do	129	165	1.80	364
May 18	do	130	180	1.88	413
June 10	do	144	306	3.45	1,790
October 15	J. E. Stewart	124	130	2.09	287

Daily gage height, in feet, of South Fork of Shoshone River at Marquette, Wyo., for 1907 and 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
1	1.05	1.3	1.4	2.9	4.7	3.8	2.35	1.7	1.25
2	1.05	1.4	1.4	.....	5.0	3.65	2.2	1.7	1.25
3	1.05	1.35	1.4	3.35	5.2	3.55	2.2	1.7	1.2
4	1.1	1.35	1.4	3.1	6.1	3.45	2.15	1.7	1.2
5	1.05	1.25	1.4	3.5	5.5	3.3	2.3	1.7	1.2
6	1.1	1.3	1.5	3.85	5.65	3.15	2.3	1.7	1.2
7	1.1	1.3	1.55	4.1	5.6	3.3	2.45	1.7	1.2
8	1.05	1.2	1.55	3.85	4.7	3.35	2.3	1.65	1.2
9	1.05	1.25	1.65	3.55	4.75	3.2	2.1	1.65	1.2
10	1.05	1.4	2.15	3.25	4.5	3.2	2.05	1.65	1.1
11	1.05	1.45	2.4	3.2	4.3	3.0	2.05	1.6	1.0
12	1.05	1.5	2.65	3.6	4.2	2.75	2.05	1.55	.....
13	1.05	1.5	2.1	3.5	4.3	2.8	2.0	1.55	.....
14	1.0	1.8	1.95	3.15	4.0	2.7	2.0	1.55	.....
15	1.0	1.9	2.0	3.05	3.9	2.9	2.0	1.7	.....

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Daily gage height, in feet, of South Fork of Shoshone River at Marquette, Wyo., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.									
16	1.05	1.9	2.6	.....	3.5	2.65	1.95	1.55	.....
17	.....	1.7	2.85	2.8	3.3	2.6	1.9	1.4	.....
18	1.05	1.7	3.0	3.3	3.2	2.65	1.9	1.4	.....
19	1.5	1.55	.....	3.8	3.8	2.7	1.9	1.4	.....
20	1.55	1.4	3.5	4.2	3.9	2.5	1.9	1.4	.....
21	1.55	1.4	3.45	4.3	3.8	2.4	1.85	1.4	.....
22	1.4	1.4	3.4	4.4	3.9	2.3	1.8	1.4	.....
23	1.3	1.5	3.5	3.9	3.9	2.2	1.75	1.35	.....
24	1.3	.....	3.15	3.6	4.0	2.3	1.75	1.35	.....
25	1.3	1.5	2.9	3.7	4.05	2.35	1.75	1.3	.....
26	4.4	1.5	.....	3.0	3.8	2.4	1.75	1.3	.....
27	.....	1.35	2.5	3.6	3.6	2.3	1.7	1.3	.....
28	.....	1.4	2.35	4.4	4.0	2.4	1.75	1.3	.....
29	.....	1.4	2.4	4.9	4.7	2.3	1.7	1.3	.....
30	.....	1.4	2.4	.....	4.05	2.45	1.7	1.3	.....
31	.....	.....	2.5	.....	3.9	2.4	.....	1.25	.....

Day.	Apr.	May	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1906.							1906.						
1	1.25	1.75	3.85	4.15	3.3	2.0	16	2.25	2.0	4.2	3.55	2.45	1.75
2	1.2	2.6	3.85	3.9	3.2	1.85	17	2.2	1.95	4.05	3.95	2.45	1.75
3	1.3	2.85	3.9	4.35	3.0	1.85	18	2.2	1.9	3.7	3.6	2.5	1.9
4	1.35	2.25	3.85	4.9	2.9	1.9	19	2.55	1.9	3.45	3.45	3.2	1.8
5	1.35	2.15	3.65	4.65	2.8	1.9	20	2.75	1.95	3.15	3.5	2.8	1.75
6	1.4	2.25	3.9	3.85	2.8	1.9	21	2.9	1.95	3.05	3.7	2.8	1.75
7	1.35	2.2	3.9	3.85	2.75	1.85	22	2.65	2.0	2.95	3.6	2.7	1.75
8	1.35	2.15	3.85	4.15	2.7	1.85	23	2.4	2.75	2.75	3.65	2.65	1.75
9	1.35	2.9	3.15	4.35	2.7	1.85	24	2.2	2.25	2.85	3.45	2.6	1.75
10	1.45	2.65	3.45	4.0	2.65	1.85	25	2.05	2.45	3.65	3.4	2.5	1.75
11	1.35	2.55	3.4	4.45	2.7	1.8	26	1.9	2.6	4.0	3.35	2.45	1.75
12	1.3	2.35	4.3	4.25	2.5	1.8	27	1.8	2.45	4.55	3.4	2.3	1.75
13	2.1	2.15	3.85	4.3	2.45	1.85	28	1.8	2.65	3.85	3.4	2.1	1.75
14	2.3	2.1	4.15	4.15	2.4	1.85	29	1.8	2.45	3.45	3.4	1.95	1.8
15	2.3	1.95	4.75	4.9	2.9	1.8	30	1.8	2.45	3.95	3.3	2.2	1.8
							31	.....	3.3	.....	3.25	2.1	.....

NOTE.—Ice conditions March 26–31, November 22 to December 31, 1907. Gage heights August 15 to November 11, 1907, and June 5 to September 30, 1908, are unreliable owing to settling of gage and uncertainty of shift in flume.

Gage heights October and November, 1907, were furnished by D. W. Cole, construction engineer, United States Reclamation Service.

Rating tables for South Fork of Shoshone River at Marquette, Wyo.

APRIL 4, 1906, TO JUNE 22, 1907, AND APRIL 1 TO JUNE 5, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
[illegible]	[illegible]	[illegible]	[illegible]	2.0	1,220	3.90	2,500
[illegible]	[illegible]	[illegible]	[illegible]	2.10	1,340	4.00	2,740
[illegible]	[illegible]	[illegible]	[illegible]	2.20	1,460	4.20	3,000
1.20	160	2.20	575	2.30	1,580	4.40	3,260
1.30	186	2.30	646	2.40	1,720	4.60	3,530
1.40	215	2.40	725	2.50	1,860	4.80	4,050
1.50	252	2.50	806	2.60	2,000	5.00	4,300
1.60	295	2.60	900	2.70	2,140		
1.70	326	2.70	1,000	2.80	2,280		
1.80	368	2.80	1,120	2.90	2,440		

[illegible] table is not applicable for low or obstructed-channel conditions. It is based on [illegible] made during 1906 and is well defined between gage heights 1.0 feet and 2.5 feet.

JUNE 22 TO AUGUST 14, 1907.

[Indirect method for shifting channels used.]

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Daily discharge, in second-feet, of South Fork of Shoshone River at Marquette, Wyo., for 1907.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1907.				1907.				1907.			
1	.....	3,360	2,260	11	.....	2,900	1,210	21	.....	2,480	.....
2	.....	3,770	2,000	12	.....	2,780	955	22	3,250	2,630	.....
3	.....	4,050	1,880	13	.....	2,960	1,000	23	2,420	2,600	.....
4	.....	5,300	1,760	14	.....	2,570	914	24	1,900	2,940	.....
5	.....	4,450	1,560	15	.....	2,470	.....	25	1,960	2,780	.....
6	.....	4,680	1,380	16	.....	1,960	.....	26	1,100	2,410	.....
7	.....	4,720	1,560	17	.....	1,740	.....	27	1,830	2,360	.....
8	.....	3,360	1,630	18	.....	1,650	.....	28	2,940	2,660	.....
9	.....	3,380	1,440	19	.....	2,490	.....	29	3,630	3,680	.....
10	.....	3,140	1,440	20	.....	2,680	.....	30	3,490	2,670	.....
								31	.....	2,400	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels. Discharges for July 4 and 7 were estimated from a comparison of hydrographs of stations at Cody and Marquette, Wyo.

Monthly discharge of South Fork of Shoshone River at Marquette, Wyo., for 1907 and 1908.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
January	.....	.....	80	0.160	0.18	4,920	C.
February	.....	.....	100	.200	.21	5,550	C.
March	269	115	161	.322	.37	9,900	B.
April	413	174	243	.486	.54	14,500	B.
May	2,000	218	844	1.69	1.95	51,900	B.
June	3,630	1,100	2,120	4.24	4.73	126,000	B.
July	5,300	1,650	3,030	6.06	6.99	186,000	B.
August	2,260	.....	915	1.83	2.11	56,300	C.
September	.....	.....	381	.762	.85	22,700	C.
October	.....	.....	218	.436	.50	13,400	C.
November	.....	.....	124	.248	.28	7,380	C.
December	.....	.....	110	.220	.25	6,760	C.
The year	.....	.....	694	1.38	18.96	505,000	
1908.							
April	1,220	161	481	.962	1.07	28,600	B.
May	1,720	347	713	1.43	1.65	43,800	B.
June 1–5	1,400	950	1,180	2.36	.44	11,700	B.

NOTE.—Owing to the unreliability of the gage heights the monthly estimates of flow for January and February, and August 14 to December 31, 1907, are made by taking 34 per cent of the discharge at the station at Cody, Wyo. These estimates are fairly approximate.

LITTLE MUDDY RIVER DRAINAGE BASIN.

DESCRIPTION.

Little Muddy River is a prairie stream that receives the drainage from an area of about 1,000 square miles—35 miles from north to south and 30 miles from east to west—in the center of Williams County, the northwestern county of North Dakota. It flows southward and joins the Missouri at Williston. About one-sixth of the whole area of the Little Muddy is drained by Stony Creek, a tributary

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which enters a few rods above its mouth. Altitudes in this basin range from 1,850 to 2,400 feet above sea level. The area is entirely without trees or shrubs, but is everywhere covered with rank prairie grass. The mean annual rainfall is about 15 inches.

Only a minor fraction of the run-off from this drainage area is carried by the stream. The entire region is deeply covered by glacial drift and there are many hollows and pools that receive the run-off and hold it till it evaporates, except when the rains are very heavy and long continued or the annual rainfall unusually great.

The headwaters of the main stream and the tributaries afford some storage sites, but only in shallow reservoirs from which evaporation is rapid. Several such reservoirs holding from 10 acre-feet to 200 each are already in use, and a number of small irrigation plants with ditches carrying 2 or 3 second-feet or less are in operation.

About 50 filings for water rights, aggregating 2,000 second-feet, were made on this stream and its tributaries prior to the passage by the legislature in 1905 of the revised irrigation code, but many of these claims have been abandoned and nearly all call for quantities greater than are ever available except sometimes during a few days of spring flood.

About 12,000 acres in this valley are included in the Williston reclamation project, 8,500 acres being under canals already completed. Owing to the variability in annual discharge of the Little Muddy, which even with complete storage would probably not furnish an adequate supply in dry years, the water for the Williston project is obtained by pumping from the Missouri.

One station has been maintained in this basin: Little Muddy River, near Williston, N. Dak., 1904 to 1908.

LITTLE MUDDY RIVER NEAR WILLISTON, N. DAK.

This station, which is located about 7 miles north of Williston, N. Dak., at the center of sec. 19, T. 155 N., R. 100 W., was established February 4, 1904, to determine the value of the stream for irrigation.

Camp Creek, a small tributary, comes in from the right a few rods below the station. The drainage area above this point is about 800 square miles.

The gage datum has not been changed since the station was established. Changes in channel conditions have been slight. Low-stage estimates of discharge are correct within a few second-feet, although the flow is so small that a change of one-tenth of a foot in gage height indicates a very large percentage change in flow. As only a few discharge measurements have been made at high water the high-stage rating table is not perfectly checked, but the monthly estimates ...mes are fairly good.

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Discharge measurements of Little Muddy River near Williston, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	J. H. Turner	22	30.5	3.30	59.5
July 12	do	8.4	8.9	2.57	8.9
August 5	Follansbee and Chandler	8.1	7.3	2.44	7.3
1908.					
May 24	G. H. Ellis		327	3.50	96
May 26	do		67	3.60	103
June 5 [a]	do		81	4.65	144
August 30	do	16	30.3	2.20	6.0
September 9	do	3.3	5.6	2.20	5.3
September 13	do	4.0	5.6	2.20	5.2

[a] Measurement made during flood; gage height fluctuated rapidly. Recorded gage height was probably at or near crest height, but measurement was made 1 mile downstream and before flood arrived. Measurement rejected.

NOTE.—These measurements were made at various sections.

Daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1907 and 1908.

[W. O. Hollar, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.										
1			4.65	3.25	3.0	2.8	2.5	2.4	2.5	2.5
2			4.75	3.35	3.0	2.8	2.4	2.4	2.5	2.5
3			4.85	3.25	3.0	2.7	2.4	2.4	2.5	2.5
4		4.6	4.8	3.05	2.9	2.7	2.4	2.4	2.5	2.5
5			4.75	3.1	2.9	2.7	2.4	2.4	2.5	2.5
6			4.85	3.2	2.8	2.7	2.3	2.4	2.5	2.5
7			4.7	3.25	2.8	2.7	2.3	2.4	2.5	2.5
8			4.8	3.35	2.9	2.7	2.3	2.4	2.5	2.5
9			4.9	3.45	3.0	2.6	2.3	2.5	2.5	2.5
10			4.9	3.5	3.0	2.6	2.3	2.5	2.5	2.5
11			5.05	3.6	3.0	2.6	2.3	2.5	2.5	2.5
12			5.0	3.6	3.0	2.6	2.3	2.5	2.5	2.5
13			4.9	3.45	3.0	2.5	2.3	2.5	2.5	2.5
14			5.25	3.3	3.0	2.5	2.3	2.5	2.5	2.5
15			5.4	3.3	3.0	2.5	2.3	2.5	2.5	2.5
16			5.65	3.3	3.0	2.5	2.3	2.5	2.5	2.5
17			5.85	3.3	3.0	2.5	2.3	2.5	2.5	.....
18			5.9	3.3	2.9	2.5	2.3	2.5	2.5	.....
19			5.6	3.3	2.9	2.5	2.3	2.5	2.5	.....
20			5.3	3.2	2.8	2.5	2.3	2.6	2.5	.....
21			5.3	3.2	2.8	2.5	2.3	2.6	2.5	.....
22		3.6	5.45	3.1	2.7	2.5	2.3	2.6	2.5	.....
23		4.1	5.7	3.0	2.7	2.5	2.3	2.6	2.5	.....
24	3.2	4.4	5.55	3.1	2.7	2.4	2.3	2.6	2.5	.....
25	3.3	4.45	5.3	3.2	2.7	2.5	2.3	2.5	2.5	.....
26			5.05	3.2	2.7	2.5	2.3	2.5	2.5	.....
27			4.7	3.2	2.7	2.5	2.3	2.5	2.5	.....
28			4.05	3.2	2.8	2.5	2.4	2.5	2.5	.....
29			3.7	3.1	2.8	2.5	2.4	2.5	2.5	.....
30			3.45	3.1	2.8	2.5	2.4	2.5	2.5	.....
31			.....	3.0	.....	2.5	2.4	.....	2.5	.....
1908.										
1			2.85	3.0	3.0	2.8	2.3	2.2	2.4	2.4
2			2.85	2.9	3.0	2.7	2.2	2.2	2.4	2.3
3			2.85	2.8	2.9	2.65	2.2	2.2	2.4	2.3
4			4.25	2.8	3.0	2.5	2.2	2.2	2.3	2.3
5			6.65	2.8	3.85	2.5	2.2	2.2	2.3	2.3
6			5.7	2.7	4.3	2.5	2.2	2.2	2.3	2.3
7			5.2	2.7	4.1	2.5	2.2	2.2	2.3	2.3
8			4.85	2.7	3.85	2.5	2.2	2.2	2.3	2.3
9			4.65	2.7	3.7	2.5	2.2	2.2	2.3	2.3
10			4.1	2.7	3.45	2.5	2.2	2.2	2.3	.....

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Daily gage height, in feet, of Little Muddy River near Williston, N. Dak., for 1907 and 1908—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.										
11				3.9	2.7	3.4	2.5	2.2	2.2	2.3
12				3.8	2.7	3.15	2.5	2.2	2.2	2.3
13				3.65	2.7	2.95	2.5	2.2	2.2	2.3
14				3.6	2.8	2.8	2.5	2.2	2.2	2.4
15				3.35	2.8	2.8	2.5	2.2	2.2	2.4
16				3.15	2.9	2.8	2.5	2.2	2.2	2.4
17				3.1	2.9	2.7	2.5	2.2	2.2	2.4
18				2.9	2.9	2.7	2.4	2.2	2.2	2.4
19				2.8	2.9	3.05	2.4	2.2	2.2	2.4
20				2.8	2.9	3.35	2.4	2.2	2.2	2.4
21				2.8	3.05	3.55	2.4	2.2	2.2	2.5
22			2.8	2.7	3.2	3.4	2.4	2.2	2.2	2.5
23			2.8	2.7	3.45	3.4	2.4	2.2	2.3	2.5
24			2.7	3.1	3.65	3.3	2.4	2.2	2.3	2.5
25			2.7	3.1	3.8	3.2	2.4	2.2	2.3	2.5
26			2.8	3.15	3.8	3.1	2.4	2.2	2.4	2.5
27			2.8	3.2	3.7	3.0	2.3	2.2	2.4	2.4
28			2.9	3.25	3.55	2.9	2.3	2.2	2.4	2.4
29			2.75	3.2	3.35	2.9	2.3	2.2	2.4	2.4
30			2.85	3.05	3.3	2.8	2.3	2.2	2.4	2.4
31			2.85	.....	3.2	.....	2.3	2.2	.....	2.4

NOTE.—Ice conditions January 1 to March 31, 1907, November 17, 1907, to March 21, 1908, and after November 9, 1908.

Rating table for Little Muddy River near Williston, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.20	5	3.30	61	4.40	405	5.50	930
2.30	6	3.40	74	4.50	450	5.60	980
2.40	7	3.50	92	4.60	495	5.70	1,035
2.50	9	3.60	114	4.70	540	5.80	1,090
2.60	12	3.70	140	4.80	585	5.90	1,145
2.70	16	3.80	170	4.90	630	6.00	1,200
2.80	21	3.90	203	5.00	680	6.20	1,310
2.90	27	4.00	239	5.10	730	6.40	1,430
3.00	34	4.10	277	5.20	780	6.60	1,550
3.10	42	4.20	318	5.30	830	6.80	1,670
3.20	51	4.30	361	5.40	880		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1904 to 1908, and is well defined between gage heights 2.2 feet and 4.0 feet. Above gage height 4.0 feet the rating curve is based on one measurement at gage height 5.4 feet.

Monthly discharge of Little Muddy River near Williston, N. Dak., for 1907 and 1908.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
April	1,140	83	696	0.870	0.97	41,400	B.
May	114	34	59.0	.074	.09	3,630	A.
June	34	16	26.2	.033	.04	1,560	B.
July	21	7	11.5	.014	.02	707	C.
	9	6	6.4	.0080	.009	394	C.
	12	7	9.0	.011	.01	536	C.
	9	9	9.0	.011	.01	553	C.
	9	9	9.0	.011	.007	286	C.
						49,100	

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Monthly discharge of Little Muddy River near Williston, N. Dak., for 1907 and 1908—Continued.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
March 22-31	27	16	20.9	0.026	0.01	415	B.
April	1,580	16	214	.268	.30	12,700	B.
May	170	16	48.1	.060	.07	2,960	A.
June	361	16	74.2	.093	.10	4,420	A.
July	21	6	8.7	.011	.01	535	C.
August	6	5	5.0	.0062	.007	307	C.
September	7	5	5.4	.0068	.008	321	C.
October	9	6	7.1	.0089	.01	437	C.
November 1-9	7	6	6.1	.0076	.003	109	C.
The period						22,200	

LITTLE MISSOURI RIVER DRAINAGE BASIN.

DESCRIPTION.

Little Missouri River rises in northeastern Wyoming, flows northward and slightly to the east through the southeastern corner of Montana and the northwestern corner of South Dakota into North Dakota, parallels the western boundary of North Dakota, near the middle of which it turns sharply and flows eastward to Missouri River at the Fort Berthold Indian Reservation. Its length by general course is about 270 miles and its drainage area comprises somewhat more than 10,000 square miles.

The Little Missouri has many small tributaries that are dry during the greater part of the year. Its only important tributary is Beaver Creek, which flows northward nearly parallel to the river for 130 miles through eastern Montana and enters the river at its big bend. This creek drains about one-fifth of the entire basin.

The upper portion of the area is mountainous, but the river flows for the most part through the high prairies—a rolling country with occasional ranges of steep hills carrying a little timber. Near the mouth of the river its altitude is 1,725 feet above sea level, but most of the basin in North Dakota is between 2,000 and 3,300 feet above sea. In the portion of the basin in North Dakota the mean annual rainfall is 12 to 16 inches, more than half of which falls in the months of May, June, and July; hence flood flows are most likely to occur in the river at two periods—in March or April, when the snow goes off, and in late May, June, or early July, following heavy precipitation. The flow is, however, very irregular. All the lower course of the river is through badlands, and as a result the stream is very flashy, rising suddenly after violent storms when there is a quick run-off from the hillsides. In a single day its discharge sometimes increases from a few score second-feet to as many thousands.

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On account of the great fluctuations in the flow of the stream, the unfavorable nature of the topography, and the absence of any rock in place that would afford a really good foundation for structures, no projects for the utilization or diversion of the main stream in its lower portion in any extensive manner, either for power or irrigation, have ever been found.

The following stations have been maintained in this basin:

Little Missouri River at Alzada, Mont., 1904–1906.
Little Missouri River at Camp Crook, S. Dak., 1903–1906.
Little Missouri River at Medora, N. Dak., 1903–1908.

LITTLE MISSOURI RIVER AT MEDORA, N. DAK.

This station, which is located at Medora, N. Dak., where the river is crossed by the Northern Pacific Railway, was established May 12, 1903, to determine the value of the stream for irrigation. The drainage area above this point is 5,780 square miles.

The gage datum has not been changed. The channel is very unstable and changes in depth at every flood. Satisfactory rating curves can not be made without very frequent discharge measurements, and the monthly estimates are liable to large errors; but as these errors are in considerable part compensating, the annual totals are supposed to be fairly good.

The station was discontinued October 31, 1908.

Discharge measurements of Little Missouri River at Medora, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 29	T. R. Atkinson	330	1,810	12.08	14,000
July 28	Chandler and Atkinson	148	378	4.79	1,020
1908.					
May 15	P. N. Ford	98	221	3.74	366
May 27	....do	278	782	7.13	3,890
August 14[a]	E. F. Chandler	53.5	39	3.46	70
August 15[a]	....do	54	42	3.50	81
August 16[a]	....do	80	87	4.28	267

[a] Made by wading.

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Daily gage height, in feet, of Little Missouri River at Medora, N. Dak., for 1907 and 1908.

[Carl Anderson and Agnus Pelette, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	4.5	4.0	3.4	10.0	4.7	4.8	3.3	3.1	2.8	2.8
2	.....	.....	4.1	3.9	3.4	9.2	4.6	4.8	3.3	3.1	2.8	2.7
3	.....	.....	4.2	3.9	3.4	8.4	4.6	4.6	3.2	3.2	2.8	2.7
4	.....	.....	4.4	3.8	3.4	7.6	4.6	4.4	3.2	3.2	2.8	2.7
5	.....	.....	4.7	3.8	3.4	6.7	4.6	4.2	3.2	3.2	2.8	2.7
6	.....	.....	5.0	3.7	3.4	6.0	4.7	4.0	3.2	3.1	2.8	2.7
7	.....	.....	5.3	3.7	3.4	5.8	4.6	3.9	3.1	3.1	2.8	2.7
8	.....	.....	5.2	3.7	3.4	5.7	4.5	3.8	3.1	3.1	2.8	2.7
9	.....	.....	5.2	3.7	3.4	5.8	4.5	3.8	3.1	3.1	2.8	2.7
10	.....	.....	5.1	3.8	3.4	5.8	4.7	3.7	3.1	3.1	2.8	2.7
11	.....	.....	5.0	3.8	3.4	5.9	5.1	3.6	3.1	3.0	2.8	2.7
12	.....	.....	5.0	3.8	3.4	5.9	5.7	3.5	3.0	3.0	2.8	2.7
13	.....	.....	4.8	3.8	3.4	6.0	5.8	3.5	3.0	3.0	2.8	2.7
14	.....	.....	4.9	3.8	3.3	6.0	6.1	3.4	3.0	3.0	2.8	2.7
15	.....	.....	5.2	3.8	3.3	6.1	6.9	3.4	3.0	3.0	2.8	.....
16	.....	.....	5.4	3.7	3.3	6.1	6.0	3.4	3.0	3.0	2.8	.....
17	.....	8.0	5.4	3.7	3.3	6.2	5.5	3.3	3.0	3.0	2.8	.....
18	.....	8.9	5.4	3.6	3.3	6.4	4.7	3.3	3.0	3.0	2.8	.....
19	.....	9.3	5.4	3.6	3.3	6.2	6.3	3.3	3.0	3.0	2.8	.....
20	.....	8.7	5.4	3.5	3.3	5.8	6.3	3.3	3.1	2.9	2.8	.....
21	.....	7.8	5.5	3.5	3.3	5.6	6.7	3.2	3.1	2.9	2.8	.....
22	.....	7.1	5.6	3.5	3.3	5.4	6.4	3.2	4.0	2.9	2.8	.....
23	.....	6.9	5.6	3.5	3.3	12.8	6.0	3.2	4.3	2.9	2.8	.....
24	.....	6.4	5.3	3.5	3.4	[a]14.5	5.6	3.2	3.9	2.9	2.8	.....
25	.....	5.9	5.0	3.5	3.5	10.0	7.0	3.2	3.6	2.9	2.8	.....
26	.....	5.7	4.7	3.5	10.0	8.0	8.5	3.1	3.4	2.9	2.8	.....
27	.....	5.6	4.5	3.5	11.3	6.2	5.6	3.1	3.3	2.9	2.8	.....
28	.....	5.0	4.3	3.5	11.5	5.6	4.8	3.2	3.2	2.9	2.8	.....
29	.....	.....	4.1	3.5	12.3	4.8	4.7	3.4	3.2	2.8	2.8	.....
30	.....	.....	4.0	3.4	12.8	4.7	4.7	3.4	3.2	2.8	2.8	.....
31	2.1	.....	4.0	.....	11.0	.....	4.7	3.3	.....	2.8	.....	2.3
1908.												
1	.....	.....	.....	4.6	4.1	7.8	5.5	3.4	3.2	4.0	.....	.....
2	.....	.....	.....	4.6	4.1	8.0	4.5	3.2	3.2	3.8	.....	.....
3	.....	.....	.....	4.6	4.0	8.1	4.4	3.2	3.2	3.6	.....	.....
4	.....	.....	.....	4.8	4.0	8.5	4.3	3.2	3.2	3.4	.....	.....
5	.....	.....	.....	4.5	4.0	9.0	4.0	3.2	3.2	3.2	.....	.....
6	.....	.....	.....	4.4	4.0	10.3	4.0	3.2	3.2	3.2	.....	.....
7	.....	.....	.....	4.3	4.0	10.1	3.9	3.2	3.1	3.2	.....	.....
8	.....	.....	.....	3.9	4.0	9.0	3.9	3.2	3.0	3.8	.....	.....
9	.....	.....	.....	3.6	4.0	8.2	3.9	3.2	3.0	4.0	.....	.....
10	.....	.....	.....	3.6	3.8	7.7	3.9	3.2	3.0	4.0	.....	.....
11	.....	.....	.....	3.5	3.7	7.0	3.9	3.2	3.0	3.8	.....	.....
12	.....	.....	.....	3.4	3.6	6.5	3.9	3.2	3.0	3.8	.....	.....
13	.....	.....	.....	3.3	3.4	5.8	3.7	3.2	3.8	3.6	.....	.....
14	.....	.....	6.0	3.3	3.2	5.5	3.7	3.2	3.4	3.7	.....	.....
15	.....	.....	5.8	3.2	3.7	5.4	3.6	3.6	3.2	3.9	.....	.....
16	.....	.....	5.6	3.2	3.6	5.3	3.9	4.5	3.0	3.9	.....	.....
17	.....	.....	5.4	3.2	3.5	5.0	4.0	5.0	3.0	4.0	.....	.....
18	.....	.....	5.2	3.2	3.4	4.8	4.2	4.6	3.8	4.0	.....	.....
19	.....	.....	4.8	3.2	3.4	4.7	4.0	4.0	3.4	4.4	.....	.....
20	.....	.....	5.0	3.2	3.9	4.7	4.0	3.7	3.1	5.0	.....	.....
21	.....	.....	5.2	3.1	4.6	4.6	4.0	3.4	3.0	5.9	.....	.....
22	.....	.....	4.4	3.1	5.2	4.5	4.0	3.4	3.0	6.0	.....	.....
23	.....	.....	4.2	3.0	5.4	4.3	5.2	3.4	3.0	5.8	.....	.....
24	.....	.....	4.0	3.0	6.0	4.2	4.7	3.4	3.0	4.7	.....	.....
25	.....	.....	3.9	2.9	6.5	4.8	4.0	3.4	3.4	4.4	.....	.....
26	.....	.....	3.8	2.9	7.1	5.2	4.0	3.4	4.0	4.3	.....	.....
27	.....	.....	3.7	4.9	7.1	5.8	3.8	3.4	3.6	4.2	.....	.....
28	.....	.....	3.6	4.6	7.1	5.9	3.7	3.4	3.5	4.1	.....	.....
29	.....	.....	3.5	4.3	7.0	5.8	3.7	3.4	4.0	3.9	.....	.....
30	.....	.....	3.6	4.2	7.2	5.6	3.6	3.3	4.2	3.7	.....	.....
31	.....	.....	3.8	.....	7.3	.....	3.5	3.2	.....	3.4	.....	.....

[a] Maximum recorded gage height was 16.0 feet at 7 a. m.

NOTE.—Probable ice conditions January 1 to February 16, 1907, December 15, 1907, to March 13, 1908.

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Rating tables for Little Missouri River at Medora, N. Dak.

MARCH 23, 1906, TO MAY 25, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	29	4.60	503	5.90	1,295	7.40	3,000
3.40	54	4.70	547	6.00	1,380	7.60	3,280
3.50	85	4.80	592	6.10	1,470	7.80	3,580
3.60	118	4.90	639	6.20	1,565	8.00	3,890
3.70	152	5.00	688	6.30	1,665	8.20	4,210
3.80	187	5.10	740	6.40	1,770	8.40	4,530
3.90	223	5.20	795	6.50	1,880	8.60	4,850
4.00	260	5.30	855	6.60	1,990	8.80	5,170
4.10	298	5.40	920	6.70	2,100	9.00	5,500
4.20	337	5.50	990	6.80	2,220	9.20	5,840
4.30	377	5.60	1,060	6.90	2,340	9.40	6,180
4.40	418	5.70	1,135	7.00	2,470		
4.50	460	5.80	1,215	7.20	2,730		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on fifteen discharge measurements made during 1905–6, and is fairly well defined below gage height 9.0 feet.

MAY 26, 1907, TO JULY 23, 1908.

2.70	4	4.00	490	5.30	1,500	7.20	3,990
2.80	8	4.10	550	5.40	1,600	7.40	4,330
2.90	14	4.20	615	5.50	1,700	7.60	4,690
3.00	24	4.30	680	5.60	1,810	7.80	5,070
3.10	44	4.40	750	5.70	1,920	8.00	5,460
3.20	80	4.50	820	5.80	2,030	8.20	5,860
3.30	120	4.60	890	5.90	2,150	8.40	6,260
3.40	165	4.70	970	6.00	2,270	8.60	6,660
3.50	210	4.80	1,050	6.20	2,520	8.80	7,080
3.60	260	4.90	1,130	6.40	2,780	9.00	7,500
3.70	315	5.00	1,220	6.60	3,060		
3.80	370	5.10	1,310	6.80	3,350		
3.90	430	5.20	1,400	7.00	3,660		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during 1907–8, and is only approximate.

JULY 24 TO OCTOBER 31, 1908.

3.00	16	3.80	139	4.60	410	5.40	930
3.10	23	3.90	162	4.70	465	5.50	1,010
3.20	34	4.00	186	4.80	520	5.60	1,090
3.30	46	4.10	213	4.90	580	5.70	1,170
3.40	60	4.20	243	5.00	640	5.80	1,250
3.50	77	4.30	277	5.10	710	5.90	1,340
3.60	96	4.40	316	5.20	780	6.00	1,430
3.70	117	4.50	360	5.30	850		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and upon the general form of the preceding curves. It is only approximate.

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Monthly discharge of Little Missouri River at Medora, N. Dak., for 1907 and 1908.

[Drainage area, 5,780 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 17-28	6,010	688	2,890	0.500	0.22	68,800	B.
March	1,060	260	671	.116	.13	41,300	B.
April	260	54	142	.025	.03	8,450	B.
May	15,500	29	2,500	.433	.50	154,000	B.
June	19,000	970	4,160	.720	.80	248,000	B.
July	6,460	820	1,820	.315	.36	112,000	B.
August	1,050	44	290	.050	.06	17,800	C.
September	680	24	115	.020	.02	6,840	C.
October	80	8	29.5	.0051	.006	1,810	D.
November	8	8	8.0	.0014	.002	476	D.
December 1-14	8	4	4.3	.00074	.0004	119	D.
The period						660,000	
1908.							
March 14-31	2,270	210	936	.162	.11	33,400	B.
April	1,130	14	383	.066	.07	22,800	B.
May	4,160	80	1,280	.221	.25	78,700	B.
June	10,200	615	3,320	.574	.64	198,000	B.
July	1,700	77	473	.082	.09	29,100	B.
August	640	34	94.5	.016	.02	5,810	C.
September	243	16	56.9	.0098	.01	3,390	C.
October	1,430	34	294	.051	.06	18,100	C.
The period						389,000	

KNIFE RIVER DRAINAGE BASIN.

DESCRIPTION.

Knife River rises in the northeastern portion of Billings County, N. Dak., and flows eastward to Missouri River at Stanton, N. Dak., 90 miles in a direct line. It drains a basin whose greatest width is 40 miles and whose area comprises about 2,500 square miles. One-fifth of this basin is drained by the chief tributary, Spring Creek, which enters the Knife about 20 miles above its mouth.

Altitudes range from 1,700 to 2,500 feet above sea level. The mean annual rainfall varies from 15 to 17 inches. There are no forests and only a few scattered trees along the streams.

Through most of the year the flow is small, but owing to the steep slopes of the sides of the valley there are occasional sudden floods after heavy rains.

The land in the lower portion of the valley is very favorably located for irrigation if the flood waters can be stored, but no really economical localities for storage have yet been found.

One station has been maintained in this basin:

Knife River at Broncho, N. Dak., 1903 to 1908.

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KNIFE RIVER AT BRONCHO, N. DAK.

This station, which is located at C. D. Smith's ranch, in the SE. ¼ sec. 4, T. 142 N., R. 90 W., the former site of the post-office of Broncho, N. Dak., was established on May 29, 1903, to determine the amount of water available for irrigation.

Spring Creek enters about 15 miles below the station and Elm Creek one-half mile above. The drainage area is 1,260 square miles.

The station was originally 2 miles farther down the river, but it was moved to its present location March 23, 1905, and since that time the gage datum has been unchanged. The drainage areas at the two locations are practically identical, the area at the lowest point being perhaps about 5 square miles greater.

The channel conditions at this point do not change perceptibly. Sufficient discharge measurements at high stages have not yet been made to check the rating curve satisfactorily, but it is approximately defined.

Discharge measurements of Knife River at Broncho, N. Dak. in 1904–1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	E. F. Chandler	87	616	11.32	2,010
July 2[a]	Raymond Richards	16	23	.86	13.5
August 6[a]	do		6.2	.71	2.9
August 21[a]	E. F. Chandler		9.0	.85	5.6
August 24[a]	do		7.4	.80	4.2
October 29[a]	L. L. Wilcox		10	.88	5.2
1905.					
March 23	E. F. Chandler	10	8.6	3.89	18
July 3	Chandler and Richards	10.5	8.4	3.6	9.8
July 5	do	52	261	7.51	632
Do	do	47	233	6.92	496
August 5	Raymond Richards	31.5	40	4.05	44
August 26	do	11	2.9	3.35	2
October 17	do	9	6.3	3.37	3.1
1906.					
April 12	E. F. Chandler	34	97	4.08	35.4
Do[b]	do	13	11	4.08	39.0
August 27[a]	do	17	28	3.87	13.5
1907.					
April 13	T. R. Atkinson	40	33.2	4.40	51.1
May 30	do	23.5	13.0	3.80	18.6
July 27[a]	Chandler and Atkinson	18	31.4	4.04	30.3
1908.					
May 30	P. N. Ford	34	74.8	4.30	61
August 10[a]	E. F. Chandler	9	5.0	3.34	2.1

[a] Made by wading. [b] Made 3 miles above the gage.

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Daily gage height, in feet, of Knife River at Broncho, N. Dak., for 1907 and 1908.

[C. D. Smith, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	5.4	4.0	3.8	3.9	3.6	3.6	3.4	3.5	3.5
2	.....	5.3	4.0	3.8	3.8	3.5	3.6	3.4	3.5	3.5
3	.....	5.2	4.0	3.8	3.6	3.4	3.6	3.4	3.5	3.5
4	.....	6.3	4.0	3.8	3.6	3.4	3.5	3.3	3.5	3.5
5	.....	6.1	4.0	3.8	3.6	3.4	3.5	3.3	3.5	3.5
6	.....	5.4	3.9	3.8	3.6	3.4	3.5	3.3	3.5	3.5
7	.....	4.9	3.9	3.8	3.5	3.4	3.5	3.3	3.5	3.5
8	.....	4.7	3.9	3.8	3.5	3.4	3.4	3.3	3.5	3.5
9	.....	4.6	3.9	3.8	3.4	3.4	3.4	3.3	3.5	3.5
10	.....	4.5	3.9	3.8	3.4	3.4	3.3	3.3	3.5	3.5
11	.....	4.5	3.9	3.8	3.4	3.4	3.3	3.3	3.5	3.6
12	.....	4.4	3.9	3.8	3.4	3.4	3.3	3.3	3.5	3.6
13	.....	4.4	3.9	3.9	3.4	3.4	3.3	3.3	3.5	3.6
14	.....	4.3	3.9	3.9	3.5	3.4	3.3	3.4	3.5	3.6
15	.....	4.3	3.9	3.9	3.5	3.4	3.3	3.4	3.5	.....
16	.....	4.2	3.9	3.9	3.5	3.4	3.3	3.4	3.5	.....
17	.....	4.2	3.9	4.0	3.6	3.4	3.3	3.4	3.5	.....
18	.....	4.2	3.9	4.0	3.6	3.4	3.3	3.4	3.5	.....
19	.....	4.2	3.8	3.9	3.6	3.4	3.3	3.4	3.5	.....
20	.....	4.2	3.8	3.9	3.6	3.4	3.3	3.4	3.5	.....
21	.....	4.2	3.8	3.9	3.6	3.4	3.3	3.4	3.5	.....
22	.....	4.2	3.8	3.9	3.7	3.4	3.3	3.5	3.5	.....
23	.....	4.2	3.8	5.7	3.7	3.4	3.3	3.5	3.5	.....
24	.....	4.2	3.8	4.7	3.7	4.1	3.3	3.5	3.5	.....
25	.....	4.2	3.8	4.6	3.6	3.9	3.3	3.5	3.5	.....
26	.....	4.1	3.8	4.2	3.6	3.8	3.3	3.5	3.5	.....
27	.....	4.1	3.9	4.1	4.1	3.8	3.4	3.5	3.5	.....
28	.....	4.1	3.9	4.1	3.9	3.8	3.4	3.5	3.5	.....
29	.....	4.1	3.9	4.0	3.9	3.7	3.4	3.5	3.5	.....
30	.....	4.0	3.9	3.9	3.8	3.6	3.4	3.5	3.5	.....
31	.....	.....	3.9	.....	3.7	3.6	.....	3.5	.....	.....
1908.										
1	.....	4.7	4.1	4.2	3.8	3.4	3.4	3.4	3.5	.....
2	.....	4.6	4.0	4.2	3.8	3.4	3.4	3.4	3.5	.....
3	.....	4.6	3.8	4.6	3.8	3.4	3.4	3.4	3.5	.....
4	.....	4.7	3.8	5.3	3.8	3.4	3.4	3.4	3.5	.....
5	.....	7.35	3.8	8.75	3.8	3.4	3.4	3.4	3.5	.....
6	.....	6.5	3.8	7.95	3.8	3.4	3.4	3.4	3.5	.....
7	.....	5.4	3.7	7.35	3.7	3.4	3.4	3.4	3.5	.....
8	.....	5.2	3.7	6.4	3.6	3.4	3.4	3.4	3.5	.....
9	.....	5.2	3.7	6.0	3.6	3.4	3.4	3.4	3.5	.....
10	.....	4.6	3.6	5.3	3.6	3.4	3.3	3.4	3.5	.....
11	.....	4.5	3.6	4.8	3.6	3.4	3.3	3.4	3.4	.....
12	6.1	4.5	3.7	4.3	3.5	3.4	3.3	3.4	3.4	.....
13	7.1	4.5	3.7	4.2	3.5	3.4	3.3	3.4	3.4	.....
14	7.7	4.6	3.7	4.1	3.5	3.4	3.3	3.4	3.4	.....
15	6.9	4.6	3.7	4.1	3.4	3.4	3.2	3.4	3.4	.....
16	6.4	4.4	3.7	4.0	3.4	3.4	3.2	3.4	3.4	.....
17	5.65	4.2	3.9	3.9	3.5	3.4	3.2	3.4	3.4	.....
18	5.5	4.1	4.1	3.8	3.5	3.4	3.1	3.4	3.4	.....
19	5.5	4.0	4.1	4.25	3.6	3.4	3.1	3.4	3.4	.....
20	6.3	4.0	4.2	5.4	3.6	3.4	3.2	3.4	3.4	.....
21	6.0	3.9	4.5	4.95	3.6	3.4	3.2	3.4	3.4	.....
22	6.3	3.9	6.15	4.4	3.5	3.4	3.3	3.7	.....	.....
23	6.2	3.9	7.15	4.15	3.4	3.4	3.3	3.7	.....	.....
24	6.0	3.8	7.35	4.05	3.4	3.5	3.3	3.6	.....	.....
25	5.5	3.8	7.4	4.0	3.4	3.5	3.3	3.5	.....	.....
26	5.0	3.8	6.5	4.2	3.4	3.5	3.3	3.5	.....	.....
27	4.9	3.9	5.7	4.2	3.5	3.5	3.3	3.5	.....	.....
28	4.8	4.4	4.7	4.0	3.5	3.5	3.3	3.5	.....	.....
29	4.8	4.3	4.4	3.95	3.5	3.5	3.3	3.5	.....	.....
30	4.8	4.2	4.2	3.9	3.5	3.4	3.4	3.5	.....	.....
31	4.7	.....	4.2	.....	3.5	3.4	.....	3.5	.....	.....

NOTE.—Probable ice conditions December 15, 1907, to March 11, 1908, and after November 21, 1908.

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Rating tables for Knife River at Broncho, N. Dak.

FOR 1904.

[Indirect method for shifting channels used for 1904.]

FOR 1905–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	0	4.60	95	6.10	336	8.20	775
3.20	1	4.70	108	6.20	354	8.40	821
3.30	2	4.80	122	6.30	373	8.60	867
3.40	4	4.90	136	6.40	392	8.80	913
3.50	7	5.00	151	6.50	411	9.00	960
3.60	10	5.10	166	6.60	431	9.20	1,010
3.70	14	5.20	181	6.70	451	9.40	1,060
3.80	19	5.30	197	6.80	471	9.60	1,110
3.90	25	5.40	216	6.90	492	9.80	1,160
4.00	32	5.50	232	7.00	513	10.00	1,210
4.10	40	5.60	249	7.20	555	11.00	1,460
4.20	49	5.70	266	7.40	597	12.00	1,710
4.30	59	5.80	283	7.60	641	13.00	2,060
4.40	70	5.90	300	7.80	685	14.00	2,310
4.50	82	6.00	318	8.00	729		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1905–1908 and is well defined between gage heights 3.2 feet and 4.5 feet. Above 4.5 feet the rating curve is based on two measurements.

Daily discharge, in second-feet, of Knife River at Broncho, N. Dak., for 1904.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1....	710	330	39	14	4	4	3	5.5	16...	670	65	52	9	3	3	5	5.5
2....	1,050	290	39	12	4	4	3	5.5	17...	490	65	52	9	3	3	5	5.5
3....	1,700	231	39	12	4	4	3	5.5	18...	310	65	26	5	3	3	5	5.5
4....	2,800	164	65	12	4	3	3	5.5	19...	196	65	26	5	4	3	5	5.5
5....	3,500	164	65	6	4	3	3	5.5	20...	134	65	26	5	4	3	5.5	5.5
6....	2,900	164	350	6	4	3	3	5.5	21...	134	58	26	5	4	3	5.5	5.5
7....	2,600	134	231	6	4	3	3	5.5	22...	120	52	26	5	4	3	5.5	5.5
8....	2,200	120	310	6	4	3	3	5.5	23...	106	45	26	5	4	3	5.5	5.5
9....	2,030	106	120	6	4	3	3	5.5	24...	134	39	26	5	4	3	5.5	5.5
10....	1,620	92	213	26	4	3	3	5.5	25...	164	39	26	5	4	3	5.5	5.5
11....	1,680	78	164	39	4	3	3	5.5	26...	164	39	26	5	3	3	5.5	5.5
12....	1,620	78	39	26	4	3	4	5.5	27...	164	39	26	5	3	3	5.5	.....
13....	1,500	65	4	26	4	3	4	5.5	28...	180	39	26	5	3	3	5.5	.....
14....	1,040	65	2	20	3	3	5	5.5	29...	196	39	26	5	3	3	5.5	.....
15....	830	65	65	14	3	3	5	5.5	30...	196	39	26	5	3	3	5.5	.....
									31...	....	39	.....	5	3	.....	5.5	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of Knife River at Broncho, N. Dak., for 1904–1908.

[Drainage area, 1,260 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1904.							
April	3,500	106	1,040	0.825	0.92	61,900	
May	330	39	94.8	.075	.09	5,830	
June	350	2	72.9	.058	.06	4,340	
July	39	5	10.3	.0082	.009	633	
August	4.0	3.0	3.65	.0029	.003	224	
September	4.0	3.0	3.10	.0025	.003	184	
October	5.5	3.0	4.42	.0035	.004	272	
November	5.5	5.5	5.50	.0044	.005	327	
The period						73,700	
1905.							
March 23–31	25	14	18.3	.015	.005	327	A.
April	14	4	7.40	.0059	.007	440	B.
May	25	4	10.4	.0083	.01	640	A.
June	597	4	81.4	.065	.07	4,840	A.
July	555	4	58.3	.046	.05	3,580	A.
August	283	1	15.8	.013	.01	972	B.
September	4	0	1.42	.0011	.001	84.5	D.
October	5.5	2	2.40	.0019	.002	148	D.
November 1–26	7.0	2	4.08	.0032	.003	210	D.
The period						11,200	
1906.							
April	1,100	8.5	116	.092	.10	6,900	A.
May	2,410	5.5	397	.315	.36	24,400	B.
June	2,420	44	748	.594	.66	44,500	B.
July	1,700	16	103	.082	.09	6,330	A.
August	36	16	24.6	.020	.02	1,510	B.
September	22	10	14.4	.011	.01	857	B.
October	10	7.0	9.71	.0077	.009	597	C.
November 1–16	10	10.0	10.0	.0079	.005	317	C.
The period						85,400	
1907.							
April	373	32	98.7	.078	.09	5,870	B.
May	32	19	24.6	.020	.02	1,510	B.
June	266	19	38.2	.030	.03	2,270	B.
July	40	4	12.1	.0096	.011	744	B.
August	40	4	8.29	.0066	.008	510	C.
September	10	2	3.86	.0031	.003	230	C.
October	7	2	4.32	.0034	.004	266	C.
November	7	7	7.0	.0056	.006	417	C.
December 1–14	10	7	7.1	.0056	.003	197	C.
The period						12,000	
1908.							
March 12–31	663	108	293	.233	.17	11,600	A.
April	586	19	102	.081	.09	6,070	A.
May	597	10	114	.090	.10	7,010	A.
June	902	19	156	.124	.14	9,280	A.
July	19	4	9.67	.0077	.009	595	B.
August	7	4	4.58	.0036	.004	282	C.
September	4	0	2.37	.0019	.002	141	C.
October	14	4	5.52	.0044	.005	339	C.
November 1–21	7	4	5.43	.0043	.003	226	C.
The period						35,500	

NOTE.—The monthly estimates of flow for 1904 are only approximate. Monthly estimates for 1905–1908 are subject to some error due to the changing conditions at this station.

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HEART RIVER DRAINAGE BASIN.

DESCRIPTION.

Heart River rises in eastern Billings County, N. Dak., flows eastward and southeastward for about 100 miles by general course, then turns abruptly to the north and northeast for 30 miles and enters Missouri River at Mandan, N. Dak. The entire drainage area is 3,350 square miles.

The largest tributaries are Big Muddy Creek, which enters from the north a few miles above the big bend and drains 480 square miles, and Green River, which is one of the headwaters and drains 340 square miles.

Altitudes range from 1,640 feet above sea level at Mandan to about 2,700 feet at the western boundary of the basin. The mean annual rainfall is from 13 to 17 inches, of which about half falls in the three months of May, June, and July. There is no forestation, merely scattering fringes and groves along the streams.

In this basin one station has been maintained:

Heart River near Richardton, N. Dak., 1903 to 1908.

HEART RIVER NEAR RICHARDTON, N. DAK.

This station, which is located at the steel highway bridge 10 miles south of Richardton, N. Dak., in or near sec. 21, T. 138, R. 92, and half a mile below the mouth of Blacktail Creek, was established May 18, 1903, to obtain data as to irrigation possibilities. The drainage area above this point is 1,250 square miles.

The datum of the gage has been unchanged, but the channel bottom is not permanent and occasional small changes in the rating curve are required. No extreme high stage measurements have yet been obtained, and not enough medium high stage measurements to properly define the upper portion of the rating curve; hence the estimates of the extreme floods are only approximate.

Discharge measurements of Heart River near Richardton, N. Dak., in 1906–1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 11	E. F. Chandler	64	61	5.05	38.4
August 29	do	18	12	4.50	18.3
1907.					
May 28	[illegible]	[illegible]	21.3	4.85	48.2
July 26	[illegible]	[illegible]	[illegible]	4.64	18.7
[illegible]	[illegible]	[illegible]	[illegible]	4.60	33
1908.					
[illegible]	[illegible]	[illegible]	[illegible]	4.39	17.6
[illegible]	[illegible]	[illegible]	[illegible]	5.24	177
[illegible]	[illegible]	[illegible]	[illegible]	4.40	3.8

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Daily gage height, in feet, of Heart River near Richardton, N. Dak., for 1907 and 1908.

[W. F. Church, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.										
1	.....	.....	6.4	4.5	4.5	4.5	4.6	4.2	4.2	4.2
2	.....	.....	6.1	4.5	4.5	4.4	4.5	4.2	4.2	4.2
3	.....	.....	5.9	4.5	4.4	4.4	4.5	4.2	4.2	4.2
4	.....	.....	5.8	4.5	4.4	4.3	4.5	4.1	4.2	4.2
5	.....	.....	5.7	4.5	4.4	4.2	4.5	4.1	4.2	4.2
6	.....	.....	5.7	4.5	4.4	4.1	4.4	4.1	4.2	4.2
7	.....	.....	5.6	4.5	4.5	4.1	4.4	4.1	4.2	4.2
8	.....	.....	5.6	4.5	4.5	4.1	4.4	4.1	4.2	4.2
9	.....	.....	5.6	4.5	4.5	4.4	4.4	4.1	4.2	4.2
10	.....	.....	5.5	4.5	4.4	4.2	4.4	4.0	4.2	.....
11	.....	.....	5.5	4.5	4.4	4.3	4.4	4.0	4.2	.....
12	.....	.....	5.4	4.5	4.4	4.2	4.4	4.0	4.2	.....
13	.....	.....	5.4	4.4	4.4	6.6	4.4	4.0	4.2	.....
14	.....	.....	5.3	4.4	4.4	6.0	4.3	4.0	4.2	.....
15	.....	.....	5.3	4.4	4.4	5.8	4.3	4.0	4.2	.....
16	5.2	.....	5.3	4.4	4.4	5.6	4.2	4.0	4.2	.....
17	6.7	.....	5.3	4.4	4.4	5.4	4.2	4.0	4.2	.....
18	8.1	6.9	5.2	4.4	4.4	5.3	4.2	4.0	4.2	.....
19	7.7	7.6	5.2	4.4	4.4	5.1	4.1	4.0	4.2	.....
20	7.4	10.1	5.2	4.4	4.4	6.8	4.1	4.3	4.2	.....
21	7.1	13.4	5.1	4.4	4.4	8.1	4.1	4.3	4.2	.....
22	6.3	14.2	5.0	4.4	4.4	6.6	4.1	4.3	4.2	.....
23	6.7	12.5	4.9	4.4	4.4	8.6	4.1	4.2	4.2	.....
24	6.7	11.3	4.8	4.4	4.4	7.9	4.8	4.2	4.2	
25	.....	10.9	4.8	4.4	4.6	7.8	4.4	4.2	4.2	.....
26	.....	10.8	4.7	4.6	6.1	7.6	4.3	4.1	4.2	.....
27	.....	9.7	4.6	4.8	5.0	7.2	4.3	4.1	4.2	.....
28	.....	9.3	4.6	4.8	4.8	6.4	4.3	4.1	4.2	.....
29	.....	8.2	4.6	4.8	4.7	4.9	4.3	4.1	4.2	.....
30	.....	7.7	4.6	4.7	4.6	4.8	4.2	4.1	4.3	.....
31	.....	6.9	.....	4.6	.....	4.7	4.2	.....	4.3	.....
1908.										
1	.....	.....	5.5	4.8	5.5	4.6	4.6	4.1	4.2	4.6
2	.....	.....	5.5	4.7	5.4	4.5	4.5	4.1	4.2	4.6
3	.....	.....	5.5	4.6	5.5	4.5	4.5	4.1	4.2	4.5
4	.....	.....	5.5	4.6	5.7	4.5	4.4	4.0	4.2	4.5
5	.....	.....	5.5	4.5	7.6	4.4	4.3	4.0	4.3	4.4
6	.....	.....	5.5	4.5	6.8	4.4	4.3	4.0	4.3	4.4
7	.....	.....	5.5	4.5	7.0	4.4	4.2	4.0	4.2	4.3
8	.....	.....	6.0	4.5	6.7	4.3	4.2	4.0	4.2	4.3
9	.....	.....	6.5	4.5	6.0	4.3	4.2	3.9	4.2	.....
10	.....	.....	6.3	4.4	5.6	4.3	4.2	3.9	4.2	.....
11	.....	4.9	6.0	4.4	5.3	4.3	4.2	3.9	4.2	.....
12	.....	5.7	6.0	4.4	5.2	4.3	4.1	3.9	4.2	.....
13	.....	5.4	5.9	4.4	6.0	4.3	4.1	3.9	4.2	.....
14	.....	5.3	5.8	4.4	6.0	4.3	4.1	3.9	4.2	.....
15	.....	7.0	5.7	4.5	5.9	4.3	4.1	3.9	4.2	.....
16	.....	7.8	5.6	4.5	5.7	4.3	4.1	3.9	4.2	4.2
17	.....	8.0	5.5	4.5	5.4	4.3	4.1	3.9	4.2	4.2
18	.....	7.9	5.1	4.4	5.2	4.3	4.1	3.9	4.2	4.2
19	.....	7.3	4.9	4.4	5.1	4.3	4.1	3.9	4.3	4.2
20	.....	7.2	4.8	4.7	5.0	4.4	4.1	3.9	4.4	4.2
21	.....	7.1	4.7	4.8	4.9	4.4	4.1	3.9	4.6	4.2
22	.....	6.8	4.7	4.9	4.9	4.5	4.0	3.9	4.8	4.3
23	.....	6.5	4.7	9.0	4.8	4.6	4.0	3.9	5.1	4.3
24	.....	6.1	4.6	10.5	4.8	4.7	4.0	3.9	5.9	4.4
25	.....	6.0	4.6	9.9	4.8	4.7	4.0	4.1	5.7	4.4
26	.....	5.9	4.6	8.3	4.8	4.6	4.0	4.2	5.4	4.4
27	.....	5.8	4.7	7.5	4.8	4.5	4.0	4.2	5.1	4.4
28	.....	5.7	4.9	6.2	4.7	4.5	4.0	4.2	4.9	.....
29	.....	5.6	4.9	6.0	4.7	4.4	4.0	4.2	4.8	.....
30	.....	5.5	4.8	5.8	4.7	5.0	4.0	4.2	4.7	.....
31	.....	5.5	.....	5.6	.....	4.8	4.0	.....	4.6	.....

ary to March, 1907, and November 10, 1907, to March 18, 1908; November 31, 1908. Water over the ice on February 16–24, 1907.

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Rating table for Heart River near Richardton, N. Dak., for 1906–1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.90	0.3	5.50	98	7.20	365	12.00	1,570
4.00	1	5.60	111	7.40	403	13.00	1,920
4.10	2	5.70	124	7.60	442	14.00	2,270
4.20	4	5.80	138	7.80	482	15.00	2,670
4.30	7	5.90	152	8.00	523	16.00	3,070
4.40	11	6.00	167	8.20	565	17.00	3,470
4.50	16	6.10	182	8.40	607	18.00	3,920
4.60	21	6.20	197	8.60	651	19.00	4,370
4.70	27	6.30	212	8.80	695	20.00	4,870
4.80	33	6.40	228	9.00	741	21.00	5,370
4.90	40	6.50	244	9.20	788	22.00	5,870
5.00	48	6.60	260	9.40	836	23.00	6,420
5.10	56	6.70	277	9.60	885	24.00	6,970
5.20	65	6.80	294	9.80	935	25.00	7,520
5.30	75	6.90	311	10.00	990	26.00	8,070
5.40	86	7.00	329	11.00	1,270		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1906–1908, and is fairly well defined between gage heights 4.0 feet and 8.0 feet. Above gage height 8.0 feet it is based on one measurement at gage height 11.10 feet and is only roughly approximate.

Monthly discharge of Heart River near Richardton, N. Dak., for 1906–1908.

[Drainage area, 1,250 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1906.							
March 26–31	812	311	503	0.402	0.09	5,990	B.
April	695	11	100	.080	.09	5,950	B.
May	1,830	11	276	.221	.25	17,000	B.
June	8,020	27	1,090	.872	.97	64,900	B.
July	33	11	24.0	.019	.02	1,480	B.
August	33	11	19.2	.015	.02	1,180	B.
September	16	4	8.0	.0064	.007	476	C.
October	7	4	4.3	.0034	.004	264	C.
November 1–16	11	7	8.0	.0064	.004	254	C.
The period						97,500	
1907.							
March 18–31	2,350	311	1,060	.848	.44	29,400	D.
April	228	21	82.2	.066	.07	4,890	C.
May	33	11	16.2	.013	.02	996	D.
June	182	11	20.7	.017	.02	1,230	D.
July	651	2	156	.125	.14	9,590	C.
August	33	2	9.3	.0074	.009	573	D.
September	7	1	2.6	.0021	.002	153	D.
October	7	4	4.2	.0034	.004	258	D.
November 1–9	4	4	4.0	.0032	.001	71.4	D.
The period						47,200	
1908.							
March 19–31	384	98	208	.166	.08	5,360	B.
April	244	21	94.2	.075	.08	5,610	B.
May	1,120	11	156	.125	.14	9,590	B.
June	442	27	112	.090	.10	6,660	B.
July	48	7	14.3	.011	.01	879	B.
August	21	1	4.1	.0033	.004	252	C.
September	4	0.3	1.26	.0010	.001	75	D.
October	152	4	24.0	.019	.02	1,480	B.
November 1–27	21	4	8.5	.0068	.007	455	C.
The period						30,400	

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CANNON BALL RIVER DRAINAGE BASIN.

DESCRIPTION.

Cannon Ball River is formed by the junction of its north and south branches (the South Branch being also known as Cedar River), which rise in the southwestern part of North Dakota and flow eastward and southeastward nearly parallel with each other for a distance of 100 miles in a direct line before joining. The drainage area of each branch is 1,700 square miles or a little more. Below the junction the stream flows northeastward 45 miles to Missouri River, which it enters 35 miles north of the South Dakota line. The total drainage area is about 4,200 square miles.

The only important tributaries are Dogtooth Creek, which enters 20 miles above the mouth of the river and drains 340 square miles, and Thirtymile Creek, which enters the North Branch 40 miles above the junction of the branches and drains 250 square miles.

The only trees grown in the Cannon Ball basin are the fringes of the streams and the occasional very small groves in the bottom land. Altitudes range from 1,600 feet at the mouth to 3,000 feet, with a few hills at the western margin rising to 3,500 feet. The mean annual rainfall varies from 12 to 17 inches in different parts of the area.

The basin contains many reservoir sites, some with capacities of 20,000 acre-feet or more. Large tracts of land in the valley might be advantageously irrigated by stored water if routes can be found for diversion canals that will not be unduly expensive, but the topography of the valley does not as a rule favor the construction of long canals, and the fall of the main river through most of its length is only from 3 to 6 feet to the mile.

One station has been maintained in this basin:

Cannon Ball River at Stevenson, N. Dak., 1903 to 1908.

CANNON BALL RIVER AT STEVENSON, N. DAK.

This station, which is located one-half mile west-northwest of the post-office at Stevenson, N. Dak., in sec. 20, T. 133, R. 82, about 40 miles south of Mandan, N. Dak., was established June 10, 1903, to determine the availability of the stream for irrigation. The station is 25 miles above the mouth of the river and 4 miles above the mouth of Dogtooth Creek. The drainage area at this point is 3,650 square miles.

The channel is of gravel and small stones and is permanent, and no appreciable changes in the rating curve from year to year are necessary. An excellent rating table has been deduced.

On account of the nature of the banks and the destruction caused by ice in the spring freshets, it is difficult to keep a gage fixed immov-

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ably and satisfactorily permanent, although it can be precisely replaced as often as necessary. Hence, systematic errors as great as 0.1 foot, or even slightly more, may sometimes have entered the daily gage record for several weeks without discovery. In 1908, owing to an unnoticed accident to the gage, the records were not accurate from the opening of the season until August 1. It seems probable that they were continuously somewhat too large for that period.

Except as thus specified, the records are satisfactory and reliable.

Discharge measurements of Cannon Ball River at Stevenson, N. Dak., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 22[a]	T. R. Atkinson	39	47.2	3.46	84
June 1[a]	do	38	42.7	3.16	78
July 23	Chandler and Hoskins	109	310	4.62	532
Do	E. F. Chandler	110	338	4.77	631
July 24	do	109	291	4.47	467
Do	do	109	287	4.33	416
July 25	do	108	267	4.16	335
July 30	Follansbee and Chandler	106	194	3.55	128
Do.[a]	do	42	67	3.54	129
1908.					
August 5[a]	E. F. Chandler	38	32.4	2.73	8.6
August 6[a]	do	38	31.6	2.71	9.0

[a] Made by wading.

Daily gage height, in feet, of Cannon Ball River at Stevenson, N. Dak., for 1907 and 1908.

[Donald Stevenson, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1			5.7	3.3	3.2	3.4	2.9		2.3	2.2	
2			5.1	3.1	3.2	3.5	2.8	2.0	2.3	2.3	
3			5.2	3.2	3.4	3.5	2.8	2.0	2.3	2.4	
4			4.9	3.2	3.4	3.4	2.2	1.7	2.4	2.5	
5			4.9	3.4	5.7	3.3	2.3	1.7	2.4	2.4	
6			4.8	3.3	7.4	3.3	2.1	1.6	2.1	2.4	
7			4.7	3.4	8.2	3.3	2.1	1.6	1.9	2.2	
8			4.6	3.5	8.4	3.8	2.1	2.1	2.1	2.3	
9			4.5	3.6	3.2	3.6	2.3	2.1	2.1	2.3	
10			4.3	3.4	3.1	3.6	2.4	2.0	2.1		
11			3.6	3.5	3.4	3.7	3.2	1.9	2.2		
12			3.4	3.1	5.6	3.5	3.2	1.9	2.1		
13			3.6	3.2	6.2	3.5	3.2	1.8			
14			3.4	3.0	5.7	3.5	3.1	1.8			
15			3.5	3.0	5.0	4.5	3.0	1.6			
16			3.2	2.9		4.5	3.0	1.8			
17	7.1		3.3	3.2		3.7	3.0	2.0		2.2	
18	9.5		3.2	3.1		3.3	2.7	2.0		2.3	
19	9.7		3.2	3.5		3.5	2.7	2.3		2.9	
20	9.8		3.1	3.4		3.7	2.5	2.3		2.7	
21	9.7		3.3	3.7		5.4	2.5	2.4		2.7	
22	9.0		3.2	3.8		5.6	2.4	1.9		2.6	
23	5.0		3.2	4.1	3.6	4.9	2.5	1.9		2.5	
24		7.2	3.2	4.6	3.7	4.7	2.3	1.8		2.0	
25		6.4	3.3	4.9	3.7	4.2	2.3	1.8		2.1	
		5.2	3.1	3.2	3.7	4.0	2.3	1.9	1.7	2.2	
		6.4	3.3	3.4	3.6	3.9	2.3	1.9		2.1	
		6.5	3.0	3.3	3.6	4.9	2.2	1.7		2.1	
		6.2	3.1	3.5	3.6	3.5	2.2	2.4		2.1	
		4.7	3.1	3.2		3.2	2.1	2.4		2.1	
		4.6		3.3		3.1	2.1		2.1		

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Daily gage height, in feet, of Cannon Ball River at Stevenson, N. Dak., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	.....	3.5	4.0	5.4	4.0	2.7	2.3	2.5	2.1	.....
2	.....	3.5	4.0	7.2	4.0	2.7	2.4	2.8	2.1	.....
3	.....	3.5	4.0	7.5	3.5	2.8	2.4	2.0	2.0	.....
4	.....	3.5	3.8	7.3	3.0	2.7	2.5	2.0	2.0	.....
5	.....	3.5	3.8	7.0	3.0	2.7	2.3	2.0	2.0	.....
6	.....	3.5	3.8	6.8	2.8	2.7	2.5	2.0	2.0	3.1
7	.....	3.5	3.5	6.5	2.5	2.7	2.5	2.1	2.0	.....
8	3.3	3.5	3.5	7.3	2.4	3.0	2.45	2.1	2.1	.....
9	4.5	3.5	3.5	7.0	3.0	2.8	2.4	2.1	2.1	.....
10	8.0	3.5	3.5	7.0	4.5	2.5	2.4	2.1	2.0	.....
11	6.0	3.5	3.5	6.5	4.8	2.4	2.4	2.0	2.0	3.1
12	6.0	3.6	3.5	7.0	4.2	2.4	2.3	2.0	2.0	.....
13	5.5	3.6	3.5	7.5	4.0	2.2	2.0	2.1	2.0	3.5
14	5.0	3.7	4.2	6.5	3.9	2.2	2.0	2.1	2.0	.....
15	4.5	3.8	4.9	6.0	3.5	2.4	2.0	2.1	.....	.....
16	5.0	3.8	4.5	5.5	3.4	2.5	2.0	2.1	.....	.....
17	6.5	3.9	5.5	5.3	4.0	2.4	2.1	2.1	.....	.....
18	7.0	4.0	5.7	5.0	4.5	2.5	2.1	3.0	.....	.....
19	8.0	4.7	5.6	4.7	4.0	2.5	2.1	4.1	.....	.....
20	9.0	4.7	5.6	4.5	3.7	2.4	2.1	4.2	.....	2.5
21	7.5	4.7	5.0	4.2	3.5	2.4	2.0	4.25	.....	.....
22	4.5	4.2	4.9	4.0	3.2	2.3	2.0	3.2	2.5	.....
23	4.5	4.5	4.9	3.5	3.0	2.3	2.0	3.0	2.5	.....
24	4.3	5.0	4.6	3.5	3.0	2.3	2.1	2.6	2.5	.....
25	4.0	5.5	4.6	3.2	2.5	2.3	2.2	3.1	2.6	.....
26	4.0	5.4	4.6	3.0	2.5	2.3	2.2	2.5	3.0	.....
27	3.9	5.2	4.4	3.0	2.4	2.0	2.1	2.8	3.0	.....
28	3.7	5.0	4.9	3.0	2.5	2.0	2.3	2.2	.....	.....
29	3.5	4.8	5.5	3.0	2.5	2.2	2.5	2.3	3.0	.....
30	3.5	4.5	6.6	3.5	2.7	2.2	2.5	2.1	.....	.....
31	3.7	.....	6.2	.....	2.7	2.25	.....	2.0	.....	.....

NOTE.—Ice conditions, January 1 to March 23, 1907; December 1, 1907, to March 10, 1908; November 12 to December 31, 1908. Water running over ice and ice gorging, February 17–22, 1907; light ice, November 17, 1907. March 8 to July 31, 1908, the gage was in poor condition and the gage heights are only approximate.

Rating table for Cannon Ball River at Stevenson, N. Dak., for 1907 and 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	0.0	3.20	58	4.40	438	6.20	1,570
2.10	.5	3.30	74	4.50	485	6.40	1,730
2.20	1.1	3.40	93	4.60	534	6.60	1,890
2.30	2	3.50	115	4.70	585	6.80	2,050
2.40	3	3.60	140	4.80	638	7.00	2,210
2.50	4	3.70	168	4.90	693	7.20	2,384
2.60	5	3.80	199	5.00	750	7.40	2,558
2.70	9	3.90	233	5.20	868	7.60	2,732
2.80	16	4.00	270	5.40	994	7.80	2,906
2.90	24	4.10	309	5.60	1,127	8.00	3,080
3.00	33	4.20	350	5.80	1,265	9.00	4,000
3.10	44	4.30	393	6.00	1,410		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on discharge measurements made during 1903–1908, and is well defined between gage heights 2.5 feet and 5.0 feet. Above gage height 5.0 feet it is based on one high-water measurement at gage height 7.18 feet and is only approximate.

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Monthly discharge of Cannon Ball River near Stevenson, N. Dak., for 1907 and 1908.

[Drainage area, 3,650 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 24–31	2,380	534	1,380	0.378	0.11	21,900	A.
April	1,200	33	264	.072	.08	15,700	A.
May	693	24	124	.034	.04	7,620	A.
June	3,450	44	655	.180	.20	39,000	A.
July	1,130	44	261	.072	.08	16,000	A.
August	58	.....	13.7	.0038	.004	842	B.
September	3.0	.....	.47	.00013	.0001	28.0	D.
October	3.0	.....	.52	.00014	.0002	32.0	D.
November	24	.....	3.0	.00082	.0009	179	D.
The period	.....	.....	.....	.....	.....	101,000	
1908.							
March 11–31	4,000	115	1,060	.291	.23	44,100	B.
April	1,060	115	358	.098	.11	21,300	B.
May	1,890	115	569	.156	.18	35,000	B.
June	2,640	33	1,210	.332	.37	72,000	B.
July	638	3	143	.039	.04	8,790	B.
August	33	0	5.45	.0015	.002	335	C.
September	4	0	1.72	.00047	.0005	102	D.
October	372	0	40.4	.011	.01	2,480	D.
The period	.....	.....	.....	.....	.....	184,000	

NOTE.—Discharge estimated for days when gage heights are missing.

GRAND RIVER DRAINAGE BASIN.

NORTH FORK OF GRAND RIVER AT HALEY, N. DAK.

The North Fork of Grand River unites with the South Fork to form the Grand in the northeastern part of Butte County, S. Dak., the main stream flowing from this junction eastward across the Standing Rock Indian Reservation to the Missouri.

This station, which is located about 20 rods south of the post-office at Haley, N. Dak., near the northeast corner of sec. 36, T. 129, R. 100, was established May 17, 1908, to obtain data for the reclamation project under survey at that point. The drainage area above the station includes only the North Fork of the Grand and comprises about 500 square miles. As no measurements at high stage have yet been made, no rating curve has been prepared.

Discharge measurements of North Fork of Grand River at Haley, N. Dak., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
11[a]	P. N. Ford	9	1.9	0.95	1.8
t 18[a]	E. F. Chandler	1.0	.19	.86	.15

[a] Made by wading.

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Daily gage height, in feet, of North Fork of Grand River at Haley, N. Dak., for 1908.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.7	1.65	1.1	0.9	0.9	0.9	0.9
2	.....	2.0	1.3	.....	.9	.9	.9	.9
3	.....	2.5	1.1	.....	.9	.9	.9	.9
4	.....	2.8	1.1	.....	.9	.9	.9	.9
5	.....	1.8	1.0	.....	.9	.9	.9	.9
6	.....	1.2	1.4	.....	.9	.9	.9	.9
7	.....	1.8	1.3	.....	.9	.9	.9	.9
8	.....	1.7	1.3	.....	.9	.9	.9	.9
9	.....	1.65	1.6	.8	.9	.9	.9	.9
10	.....	1.5	1.3	.....	.9	.9	.9	.9
11	.....	1.4	1.0	.....	.9	.9	.9	.9
12	.....	1.45	.9	.....	.9	.9	.9	.9
13	.....	1.3	.9	.....	.9	.9	.9	.9
14	.....	2.8	.9	.....	.9	.9	.9	.9
15	.....	4.7	.9	.....	.9	.9	.9	.9
16	.....	3.0	.9	.85	.9	.9	.9	.9
17	1.0	3.0	.85	.85	.9	.9	.9	.9
18	1.0	2.05	.....	.85	.9	.9	.9	.9
19	1.0	1.2	1.1	.85	.9	1.0	.9	.9
20	3.8	1.9	1.1	.85	.9	1.0	.9	.9
21	4.8	1.4	1.1	.85	.9	1.0	.9	.9
22	5.5	1.8	1.1	.85	.9	.9	.9	.9
23	5.6	1.3	1.1	.85	.9	.9	.9	.9
24	3.8	1.1	1.1	.85	.9	.9	.9	.9
25	3.8	1.2	1.1	.85	.9	.9	.9	.9
26	3.2	1.4	1.1	.85	.9	.9	.9	.9
27	2.75	1.9	1.1	.85	.9	.9	.9	.9
28	2.0	1.4	1.1	.9	.9	.9	.9	.9
29	1.8	1.0	1.1	.9	.9	.9	.9	.9
30	1.8	1.7	1.1	.9	.9	.9	.9	.9
31	1.8	.....	1.1	.9	.....	.9	.....	.9

NOTE.—Ice conditions November 5 to December 31.

NIOBRARA RIVER DRAINAGE BASIN.

DESCRIPTION.

Niobrara River rises in the mountains of eastern Wyoming, flows eastward through the northern portion of Nebraska, and empties into the Missouri in Knox County at the city of Niobrara. Its drainage basin is narrow in the upper portion but broadens considerably near the mouth; it comprises about 9,000 square miles.

Precipitation within the basin varies from 15 to 18 inches in the upper portion, from 18 to 21 inches in the middle portion, and from 21 to 24 inches in the lower portion. Evaporation is 6, 5, and 4½ feet in the upper, middle, and lower portions, respectively. Sixty-nine per cent of the precipitation falls during April, May, June, July, and August, and about one-half of the remainder is snowfall.

The river is not subject to periodic rises of any importance, owing to the fact that the sand hills which form so large a portion of its drainage area act as storage reservoirs for the rain and snow, which are afterwards fed to the stream in the form of spring water, thus equalizing the flow and making the constancy of the discharge almost phenomenal.

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The principal tributaries are Verdigris, Keyapaha, and Snake rivers, and Minnechaduza Creek. The drainage area of the Snake is similar in nearly all respects to that of the western part of the Niobrara.

The water resources of the Niobrara are at present almost wholly undeveloped, irrigation being limited to the low, narrow flood plains in the bottoms of the canyons. On Minnechaduza Creek at Valentine an artificial lake has been formed by a dam, and a power plant has been installed for lighting and for furnishing the city with water. On the lower course of the Niobrara a number of mills are in operation, receiving their power from small tributaries. On Snake River opportunities for power development are phenomenal, but long transmission lines would be required to make it of practical value.

The following gaging stations have been maintained in this basin:

Niobrara River near Valentine (Fort Niobrara), Nebr., 1897, 1899, 1901–1906.
Niobrara River near Spencer, Nebr., 1908.
Niobrara River near Niobrara, Nebr., 1902.
Red Deer Lake near Woodlake, Nebr., 1904–5.

NIOBRARA RIVER NEAR SPENCER, NEBR.

This station, which was established May 15, 1908, and discontinued December 31, 1908, is located at the Whiting highway bridge, 6½ miles south of Spencer, in sec. 30, T. 33 N., R. 11 W.

The records at this point show practically the entire flow of the river, Verdigris River being the only important tributary below. Keyapaha River enters 20 miles above.

A few ditches taking water for irrigation for the low, narrow flood plain constitute the only diversion from the river. Ice probably does not affect results materially. Measurements are difficult on account of the high velocity of the current. The bed is composed partly of shifting sand, and frequent measurements are necessary to obtain good results. Sufficient data have not been obtained to form a basis for computations of discharge.

Discharge measurements of Niobrara River near Spencer, Nebr., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	G. W. Bates	117	409	4.80	2,830
May 16	do	120	400	4.70	2,830
June 11	Arthur Dobson	138	389	4.55	2,590
July 23	do	150	334	4.60	1,280
September 9	do	150	189	4.62	867

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Daily gage height, in feet, of Niobrara River near Spencer, Nebr., for 1908.

[A. J. Lamb, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.6	4.4	4.5	4.3	4.6	4.6	5.1
2	.....	4.5	4.5	4.4	4.7	4.5	4.5	4.8
3	.....	4.5	4.4	4.5	4.6	4.7	4.7	4.9
4	.....	4.4	4.3	4.6	4.4	4.5	4.8	5.1
5	.....	4.8	4.3	4.7	4.7	4.7	4.8	5.0
6	.....	4.6	4.3	4.6	4.5	4.9	4.8	5.5
7	.....	5.0	4.2	4.4	4.9	4.8	4.7	5.1
8	.....	4.5	4.3	4.3	4.7	4.6	4.8	5.2
9	.....	4.8	4.4	4.6	4.6	4.6	4.7	5.1
10	.....	4.5	4.5	4.7	5.0	4.7	4.8	5.2
11	.....	4.5	4.4	5.0	5.0	4.6	4.7	5.3
12	.....	4.9	4.3	4.6	4.8	4.6	4.8	5.1
13	.....	6.0	4.4	4.4	4.7	4.7	5.0	5.0
14	.....	4.4	4.3	4.3	4.8	4.6	5.1	5.0
15	4.8	4.5	4.4	4.6	5.0	4.6	5.0	5.2
16	4.5	4.6	4.6	4.6	5.0	4.7	4.8	5.0
17	4.7	4.6	4.6	4.8	5.0	4.6	5.0	4.7
18	4.6	5.5	4.7	4.5	4.8	4.6	5.8	4.7
19	4.7	4.8	4.5	4.6	4.9	4.7	5.4	4.8
20	4.5	4.2	4.5	4.5	5.0	5.4	4.9	4.7
21	4.6	4.1	4.8	4.3	5.0	5.2	4.8	4.8
22	4.5	4.7	4.6	4.5	5.0	5.0	4.8	5.0
23	4.6	5.9	4.6	4.3	5.0	4.7	4.9	4.8
24	4.3	4.5	4.8	4.6	4.8	4.6	4.9	4.9
25	4.7	4.4	4.7	4.6	4.8	4.7	4.9	5.0
26	4.4	4.4	5.0	7.0	6.0	4.8	5.3	5.0
27	4.8	4.2	4.6	5.0	4.5	4.7	5.0	5.2
28	4.5	4.4	4.5	4.7	4.4	4.6	5.3	5.0
29	4.6	4.4	4.4	4.6	4.5	4.5	5.2	4.9
30	4.6	4.4	4.5	4.8	4.7	4.7	5.6	4.7
31	4.5	.....	4.5	4.6	.....	4.8	.....	4.8

NOTE.—Possible ice conditions during December.

PLATTE RIVER DRAINAGE BASIN.

GENERAL FEATURES.

Considered only with regard to extent of the area drained, the Platte is the most important tributary of the Missouri. It is formed by two forks, North Platte and South Platte, which rise, respectively, in northern and in central Colorado and unite a little southwest of the center of Nebraska. Its entire drainage basin comprises about 84,000 square miles, of which 28,500 square miles belong to the North Platte and 24,000 to the South Platte. The lower course of the river is fairly well settled, but farther west the population is more scattered.

For convenience the description of the basin is divided, and the North Platte, Platte River proper, and South Platte are considered separately, being arranged in downstream order.

NORTH PLATTE RIVER DRAINAGE BASIN.

DESCRIPTION.

The source of North Platte River is in North Park, Colorado, or rather in the mountains which, rising to elevations from 4,000 to 5,000 feet above its general level, hem it in on all sides. The park is

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just east of the Continental Divide, some of the peaks of which in that locality exceed 12,000 feet in altitude. From the steep slopes of the mountains numerous small streams descend, unite below into large creeks, and flow outward to the center of the basin. The two which may be said to form the real head of the North Platte are Grizzly and Little Grizzly creeks, but within the park the river is joined by four large tributaries, Roaring Fork and North Fork from the west and Michigan and Canadian creeks from the east. Leaving the park, the river makes a bold curve northward into Wyoming, but near Casper, on the north side of the Casper Range, it turns abruptly to the east and southeast, maintaining the latter course to its point of junction with the South Platte in central Nebraska.

Within North Park the topographic features are diversified, including every degree of roughness from the snow-capped peaks of the Park and Medicine Bow ranges to the level prairie mesas along the lower portion of the stream. Dense forests cover the mountain tracts, the heaviest being those on the east slope of the Park and the west slope of the Medicine Bow ranges. At an elevation of 8,500 feet above sea level the forests give way to the open prairie country, which, with the exception of the dense growth of willows along the river bottoms, is entirely free from forests of any description.

The soil, composed principally of sandy and gravelly loam on the mesas and of sandy and black loam along the river bottoms, is in general fertile, but climatic conditions are such that the agricultural products are limited to wild hay, roots, and a few of the hardier grains.

In its northward course through Wyoming the stream receives many tributaries, the Snowy Range on the east contributing its drainage through Douglas, French, and Brush creeks, while the northeast slope of the Sierra Madre is drained by Beaver, Big Cow, and Spring creeks and Grand Encampment River. Medicine Bow and Sweetwater rivers are added to the North Platte between Saratoga and Casper, beyond which the only important tributary is the Laramie, which enters at old Fort Laramie.

The greater part of the region below Saratoga is a rolling, undulating prairie. The soil throughout Wyoming is a sandy loam of sufficient depth to produce meadows of rich grasses, even up to elevations of 7,000 feet. At lower elevations the soil becomes more friable and deeper.

Throughout its course in western Nebraska the valley of the North Platte is 10 to 15 miles wide. The present floor, consisting of sediments deposited in a former greater valley, is bordered by terraces and table-lands scarred by numerous tributaries and arroyos. The stream is broad and shallow, with a flood plain from 1 mile to 4 miles wide.

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A. PATHFINDER DAM SITE BEFORE CONSTRUCTION, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

B. PATHFINDER DAM, NORTH PLATTE PROJECT, NEBRASKA-WYOMING.

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The character of the river bed at the Big Bend and at the Seminoe Mountains, in Wyoming, seems to indicate a considerable underflow. A part of this is collected at the Big Bend, and probably the entire amount is brought to the surface as the river passes through the Seminoe Range. In its lower course the bed of the stream is of fine quicksand underlain at a depth of 15 to 20 feet by a hard layer which seems to be clay.

The total length of the river from source to mouth is nearly 650 miles. At Pinkhampton, Colo., it is about 8,000 feet above sea level; at Fort Steele, Wyo., about 500 miles above its mouth, it is 6,500 feet; and at Fort Laramie it is 4,200 feet, and at North Platte, Nebr., 2,800 feet.

The drainage area includes about 28,800 square miles, of which 1,800 square miles are in Colorado, 20,000 in Wyoming, and nearly 7,000 in Nebraska.

In the mountain districts precipitation, usually in the form of snow during the winter and spring months, varies from 7 to 15 inches, the average being about 11 inches; in the high mountains it is 20 inches and upwards. Throughout the lower portion of the basin the precipitation is from 15 to 18 inches, and the evaporation from the water surface is 5 to 6 feet annually.

The stream is subject to periodic floods which reach the maximum at the mouth some time during the latter part of June and are caused by the melting snow on the high ranges. The river runs lowest in winter and is usually covered with thick ice. High water prevails from the middle of April until the middle of July, during which period the river is frequently bank full.

The winters are quite severe throughout the entire basin of this stream, and particularly so above an altitude of 4,000 feet. On the plains areas, although there is considerable snowfall, the snow does not lie for more than a few days at a time.

Agriculture in the basin of the North Platte has been confined largely to the valleys of the tributaries, and most of the available agricultural lands on these tributaries are now occupied. At present irrigation is most extensively practiced on Laramie and Little Laramie rivers in the vicinity of Laramie; on the Laramie in the vicinity of Wheatland, and on the North Platte itself for a considerable distance on both sides of the Wyoming-Nebraska line.

The Laramie-Poudre project will divert a considerable portion of the flow of Laramie River in Colorado across the divide by means of a tunnel into the headwaters of the Cache la Poudre, where the waters will be used to irrigate land in the South Platte drainage. Construction is about to be begun on this project. The nearly completed North Platte project of the Reclamation Service will provide for the

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Michigan Creek near Cowdrey, Colo., 1904–5.
Canadian River at Cowdrey, Colo., 1904–5.
Grand Encampment Creek near Peryam's ranch, Wyo., 1900.
Medicine Bow River near Medicine Bow, Wyo., 1901.
Sweetwater River near Splitrock, Wyo., 1902–3.
Laramie River at Glendevey, Colo., 1904–5.
Laramie River near Jelm, Wyo., 1904–5.
Laramie River near Woods Landing, Wyo., 1895–1900.
Laramie River near Uva, Wyo., 1895–1900, 1903.
McIntyre Creek near Gleneyre, Colo., 1904–5.
Little Laramie River near Hatton, Wyo., 1902–3.
Little Laramie River near Laramie, Wyo., 1903.

NORTH PLATTE RIVER AT PATHFINDER, WYO.

This station, which is located one-half mile south of Pathfinder post-office and 500 feet below the mouth of the canyon, in sec. 24, T. 29 N., R. 84 W., sixth principal meridian, Wyoming, was established May 9, 1905, and has been maintained by the United States Reclamation Service to show the amount of water available for storage in connection with the North Platte project.

The Pathfinder dam site (Pl. X, *A*) is about one-fourth mile above the station, which is at an elevation of nearly 5,700 feet. Sweetwater River enters the North Platte about 3 miles above the station. The drainage area is about 12,000 square miles.

Very little water is diverted above the station. Some land is irrigated on the North Platte and its tributaries, but opportunities for much additional development can be found.

The datum of the gage has remained constant during the maintenance of the station. The flow is affected by ice for several months during the winter season. The results obtained at this station have been on the whole very satisfactory.

Discharge measurements of North Platte River at Pathfinder, Wyo., from 1905 to 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 26	L. V. Branch	.....	507	0.88	189
October 3	do	.....	640	1.57	426
Do	do	.....	633	1.57	434
November 15	do	.....	597	1.32	315
1906.					
February 8 [a]	Branch and Sussex	79	381	1.80	199
February 22 [a]	do	82	426	1.97	279
April 5	do	199	1,090	4.00	2,180
May 11	L. V. Branch	204	1,410	5.52	4,190
May 22	J. W. Sussex	209	1,840	7.40	8,180
June 22	Branch and Sussex	203	1,590	6.47	6,000
1907.					
May 23	L. V. Branch	230	1,980	8.25	9,930
June 18	do	249	2,160	8.92	11,400
1908.					
February 17 [a]	L. V. Branch	171	515	[b] 1.58	349

[a] Gaging made through ice.
[b] Gage height to water surface through hole in ice. Ice 18 inches thick.

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Daily gage height, in feet, of North Platte River at Pathfinder, Wyo., for 1905, 1907, and 1908.[a]

[Charles E. Hamilton and William F. Costello, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1						6.95	5.42	2.40	1.00	1.20	1.55	1.30
2						7.18	5.05	2.45	1.00	1.65	1.50	1.40
3						7.45	4.85	2.72	1.00	1.65	1.38	1.35
4						7.78	5.10	2.62	1.00	1.40	1.25	1.45
5						8.70	5.02	2.50	.98	1.35	1.45	1.30
6						9.20	4.72	2.32	1.60	1.28	1.60	1.32
7						8.95	4.40	2.18	1.58	1.25	1.75	1.25
8						8.85	4.00	2.15	1.38	1.25	1.82	1.30
9						8.88	3.65	2.10	1.60	1.20	1.80	1.30
10					4.05	9.28	3.65	2.05	1.48	1.20	1.80	1.10
11					4.42	9.50	3.65	2.00	1.42	1.15	1.75	1.30
12					4.50	9.15	3.65	1.92	1.38	1.15	1.60	1.25
13					4.30	8.92	3.50	2.10	1.28	1.20	1.50	1.28
14					4.10	8.68	3.32	2.35	1.08	1.20	1.48	1.20
15					3.98	8.10	3.18	2.22	.88	1.20	1.45	1.25
16					3.90	8.22	3.10	2.05	1.00	1.30	1.50	1.28
17					3.82	8.12	3.00	2.00	1.00	1.40	1.55	1.25
18					3.95	8.12	2.92	1.95	1.00	1.40	1.58	1.20
19					4.48	7.75	2.85	1.80	.95	1.40	1.65	1.22
20					5.22	7.30	2.85	1.68	.90	1.40	1.65	1.22
21					6.02	6.95	2.95	1.48	.85	1.48	1.70	1.18
22					6.32	6.75	2.88	1.35	.85	1.35	1.60	1.22
23					6.70	6.68	2.80	1.30	.85	1.40	1.42	1.20
24					6.98	6.60	2.75	1.30	.90	1.38	1.30	1.15
25					7.28	6.75	2.68	1.25	.88	1.45	1.10	1.08
26					7.20	6.42	2.58	1.22	.88	1.50	1.10	1.15
27					7.25	6.28	2.52	1.20	.85	1.60	1.35	1.22
28					7.15	6.12	2.48	1.22	.82	1.60	1.45	1.20
29					7.35	5.78	2.68	1.08	.80	1.62	1.30	1.18
30					7.12	5.68	2.58	1.00	1.00	1.60	.85	1.20
31					6.92	.....	2.48	1.00	.....	1.55	.....	1.20
1907.												
1	1.92	2.00	2.05	3.25	4.35	6.95	8.08	4.35	2.35	1.82	1.95	1.60
2	1.85	1.92	2.20	3.10	4.15	6.82	8.10	4.20	2.28	1.90	1.95	1.55
3	1.55	1.95	2.15	3.18	4.05	7.12	8.22	4.00	2.20	1.95	1.90	1.48
4	1.70	2.08	2.58	3.25	3.92	7.78	8.20	3.90	2.20	2.00	1.90	1.40
5	1.50	2.08	2.68	3.58	3.92	7.95	8.05	3.85	2.15	2.02	1.85	1.42
6	1.78	2.28	2.52	3.72	3.92	8.22	8.08	3.75	2.08	2.10	1.85	1.45
7	1.85	2.35	2.60	3.82	3.90	8.78	7.92	3.98	2.00	2.10	1.88	1.45
8	1.92	2.52	2.60	3.82	3.85	9.10	7.78	3.75	1.98	2.15	1.90	1.62
9	1.88	2.48	2.60	3.68	3.80	9.22	7.52	3.48	1.95	2.10	1.85	1.52
10	1.70	2.40	2.60	3.38	3.85	9.18	7.28	3.32	2.00	2.18	1.78	1.35
11	1.80	2.45	2.60	3.35	3.85	8.62	7.12	3.18	2.05	2.20	1.72	1.42
12	1.88	2.45	2.60	3.80	4.12	8.32	6.92	3.05	2.08	2.22	1.58	1.50
13	1.90	2.42	2.60	4.52	4.80	8.30	6.60	3.00	1.98	2.22	1.42	1.45
14	1.92	2.38	2.32	4.95	5.28	8.50	6.38	2.90	1.88	2.20	1.30	1.50
15	1.98	2.42	2.22	4.92	5.52	8.62	6.38	2.82	1.78	2.20	1.30	.82
16	1.92	2.40	2.30	5.10	5.42	8.80	6.68	2.70	1.70	2.10	1.30	1.00
17	1.85	2.42	2.35	5.50	5.25	8.95	6.45	2.78	1.70	2.08	1.30	1.10
18	1.98	2.45	2.52	5.68	5.22	8.92	6.02	2.70	1.70	2.05	1.38	.75
19	1.85	2.48	3.18	5.38	5.55	8.90	5.55	2.62	1.75	2.05	1.52	1.10
20	1.78	2.60	3.80	4.92	6.30	8.90	5.25	2.60	1.80	2.02	1.42	1.00
21	1.70	2.78	5.25	4.25	7.00	8.65	5.05	2.60	1.75	1.92	1.45	1.40
22	1.88	2.75	6.50	4.08	7.65	8.58	4.95	2.58	1.75	1.95	1.30	1.28
23	1.75	2.85	7.00	4.10	8.18	8.52	4.90	2.52	1.80	1.95	1.22	1.30
24	1.88	2.82	5.90	4.08	8.60	8.60	4.88	2.50	1.70	1.92	1.30	1.38
25	1.90	2.78	4.90	4.20	8.60	8.40	4.80	2.42	1.68	1.90	1.30	1.40
26	1.90	2.82	4.52	4.10	8.48	8.38	4.68	2.38	1.70	1.88	1.38	1.42
27	1.82	2.65	4.40	4.18	7.90	8.30	4.62	2.30	1.38	1.85	1.50	1.45
28	1.98	2.22	3.90	4.05	7.50	8.15	4.88	2.38	1.38	1.85	1.50	1.40
29	1.92	.....	3.40	4.25	7.32	8.20	5.02	2.35	1.52	1.88	1.55	1.40
30	1.95	.....	3.40	4.35	7.22	8.02	4.98	2.48	1.65	1.90	1.68	1.40
31	1.98	.....	3.35	.....	7.05	.....	4.68	2.38	.....	1.95	.....	1.40

[a] The following gage heights for this station for 1906 were missing in the 1906 report (Water-Supply Paper 198): January 1, 1.12 feet; January 2, 1.05 feet; January 3, 0.85 foot; January 4, 1.12 feet; January 5, 1.40 feet; January 6, 1.40 feet.

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Daily gage height, in feet, of North Platte River at Pathfinder, Wyo., for 1905, 1907, and 1908—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	1.35	1.5	1.65	2.5	3.25	5.5	4.5	3.0	2.15	1.7	2.3	1.1
2	1.35	1.5	1.65	2.45	3.3	5.5	5.2	3.0	2.1	1.7	2.3	1.2
3	1.4	1.5	1.75	2.9	3.35	5.6	5.05	2.8	2.0	1.75	2.35	1.7
4	1.4	1.5	1.8	2.7	3.4	5.5	5.0	2.8	1.99	1.8	2.35	1.8
5	1.4	1.5	1.7	2.2	3.6	5.4	5.0	2.7	1.85	1.8	2.3	1.9
6	1.4	1.5	1.65	2.2	3.7	5.3	4.95	2.5	1.8	1.8	2.25	1.9
7	1.35	1.5	1.65	2.35	3.5	5.2	5.0	2.4	1.75	1.95	2.15	1.7
8	1.35	1.5	1.65	2.5	3.5	5.15	4.95	2.4	1.75	1.95	2.1	1.5
9	1.35	1.55	1.65	2.6	3.6	5.2	4.9	2.4	1.7	1.95	2.15	1.5
10	1.35	1.55	1.7	2.7	3.95	5.2	4.7	2.4	1.65	1.95	2.15	1.65
11	1.35	1.55	1.7	2.7	4.1	5.35	4.5	2.5	1.65	2.0	1.85	1.4
12	1.35	1.5	1.7	2.9	4.0	5.5	4.1	2.4	1.6	2.0	1.3	1.1
13	1.35	1.5	1.7	3.1	3.9	5.65	3.7	2.5	1.7	1.95	1.4	1.3
14	1.35	1.5	1.8	3.1	3.75	5.9	3.5	3.2	1.8	1.9	1.5	1.6
15	1.35	1.55	1.9	3.3	3.7	6.0	3.5	3.2	2.1	1.8	1.4	1.9
16	1.35	1.6	2.15	3.55	3.65	6.15	3.7	3.3	2.1	1.8	1.7	1.8
17	1.35	1.6	2.35	3.7	3.6	6.3	3.6	3.1	1.9	1.8	1.95	1.55
18	1.35	1.55	2.6	3.9	3.7	6.4	3.4	3.0	1.9	1.9	1.95	1.15
19	1.4	1.55	2.6	4.0	3.9	6.4	3.2	3.0	1.8	1.9	2.0	1.6
20	1.5	1.5	2.6	4.1	3.9	6.5	3.15	3.0	1.7	2.1	1.95	1.5
21	1.5	1.5	2.6	4.1	4.25	6.55	3.05	3.05	1.65	2.1	2.0	1.7
22	1.5	1.5	2.55	4.15	4.5	6.5	2.85	3.0	1.55	2.2	2.0	1.65
23	1.5	1.5	2.5	4.3	4.3	6.4	2.7	4.0	1.55	2.15	1.95	1.85
24	1.5	1.5	2.5	4.4	4.25	6.4	2.55	3.6	1.5	2.0	1.9	2.0
25	1.5	1.5	2.6	4.45	4.35	6.3	2.5	3.4	1.5	2.05	1.9	1.9
26	1.5	1.5	2.7	4.05	4.85	6.2	2.4	2.95	1.6	2.1	1.8	2.2
27	1.5	1.55	2.7	3.9	5.25	6.25	2.3	2.8	1.65	2.2	1.6	2.3
28	1.5	1.6	2.65	3.65	5.4	3.4	2.3	2.6	2.05	2.3	1.65	2.15
29	1.5	1.6	2.65	3.5	5.5	3.5	2.5	2.4	1.85	2.25	1.5	2.1
30	1.5	.....	2.6	3.4	5.45	3.6	2.95	2.3	1.8	2.2	1.4	2.2
31	1.5	.....	2.5	.....	5.4	.....	2.5	2.2	.....	2.2	.....	2.2

NOTE.—River frozen over after November 29, 1905. Ice conditions January 1 to February 27, 1907, and December 15, 1907, to February 29, 1908, and after November 12, 1908. On February 17, 1908, the ice was 12 inches thick. There was a little ice March 5 to 15, 1908, which probably did not materially affect the gage heights. The flow was affected at times from April to July, 1908, by gate regulation of the Pathfinder Tunnel.

Rating table for North Platte River at Pathfinder, Wyo., for 1905 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	168	2.10	714	3.40	1,630	5.40	4,020
.90	192	2.20	774	3.50	1,720	5.60	4,360
1.00	218	2.30	836	3.60	1,810	5.80	4,730
1.10	245	2.40	900	3.70	1,900	6.00	5,110
1.20	276	2.50	966	3.80	2,000	6.20	5,515
1.30	313	2.60	1,032	3.90	2,100	6.40	5,935
1.40	354	2.70	1,100	4.00	2,200	6.60	6,360
1.50	397	2.80	1,168	4.20	2,400	6.80	6,800
1.60	444	2.90	1,236	4.40	2,600	7.00	7,240
1.70	494	3.00	1,308	4.60	2,830	8.00	9,440
1.80	546	3.10	1,382	4.80	3,100	9.00	11,650
1.90	600	3.20	1,460	5.00	3,400		
2.00	656	3.30	1,540	5.20	3,700		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on 10 discharge measurements made in 1905-1907, and is well defined. Above gage height 6.6 feet the rating curve is a tangent, the difference being 2.20 per tenth.

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Monthly discharge of North Platte River at Pathfinder, Wyo., for 1905 to 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1905.					
May 10–31	8,010	2,020	4,790	209,000	A.
June	12,800	4,500	8,800	524,000	A.
July	4,050	953	1,800	111,000	A.
August	1,110	218	597	36,700	A.
September	444	168	249	14,800	A.
October	469	260	349	21,500	A.
November 1–28	556	245	413	22,900	A.
The period				940,000	
1906.					
April	4,820	1,790	3,030	180,000	A.
May	12,000	2,350	6,180	380,000	A.
June	11,000	3,180	7,390	440,000	A.
July	3,250	913	2,260	139,000	A.
August	933	434	666	41,000	A.
September	1,020	397	664	39,500	A.
October	1,050	305	575	35,400	A.
November 1–17	1,020	685	873	29,400	A.
The period				1,280,000	
1907.					
March	7,240	685	1,890	116,000	A.
April	4,500	1,380	2,440	145,000	A.
May	10,800	2,000	5,070	312,000	A.
June	12,100	6,840	10,300	613,000	A.
July	9,920	2,850	6,010	370,000	A.
August	2,550	836	1,380	84,800	A.
September	868	346	587	34,900	A.
October	786	557	669	41,100	A.
November	628	283	440	26,200	A.
December	454	157	315	19,400	C.
The period				1,760,000	
1908.					
January			292	18,000	D.
February			348	20,000	D.
March	1,100	469	759	46,700	B.
April	2,660	774	1,620	96,400	A.
May	4,180	1,500	2,370	146,000	A.
June	6,250	1,630	4,590	273,000	A.
July	3,700	836	2,030	125,000	A.
August	2,200	774	1,210	74,400	A.
September	744	397	544	32,400	A.
October	836	494	645	39,700	A.
November 1–15	868	313	666	19,800	B.
The period				891,000	

NOTE.—Discharge estimated December 21, 1907, to February 29, 1908. This is the only ice period for which there is sufficient data to warrant even an approximate estimate of discharge.

NORTH PLATTE RIVER AT GUERNSEY, WYO.

This station, which was established June 14, 1900, to obtain statistical data concerning the flow of the river, was originally located at the highway bridge about one-half mile northwest of Guernsey, Wyo., in sec. 35, T. 27 N., R. 66 W., but at the opening of the season of 1902 the gage was removed to the railroad bridge, 300 feet above the first location. Discharge measurements have been made from the highway bridge. During the last few years the records obtained have been especially valuable to the United States Reclamation Service in connection with the North Platte project.

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The station is located about 15 miles above the mouth of Laramie River. No other important tributaries come in anywhere in the vicinity of the station. The drainage area above the station is about 16,000 square miles, and the elevation of the gage zero is 4,317 feet above sea level. The station was abandoned November 30, 1908.

Very little irrigation is practiced along the North Platte proper above this point, but there are many diversions for irrigation on the tributary streams. The canal systems of the North Platte project will divert water a few miles below the station.

At the beginning of the season of 1902, when the gage was removed to the new location, the datum was changed. This gage was washed out by flood waters on June 1, 1908, and was replaced on June 13, 1908, by another rod gage at the same location but with the datum 1 foot lower.

About June 3, 1908, a maximum height of 11.50 feet (old gage datum), said to be the highest for over twenty years, was recorded.

Owing to the shifting character of the channel, comparatively frequent measurements are necessary to obtain the best results.

During the winter seasons the river is frequently covered with ice a foot or more in thickness, and results are affected by ice for about three months each year.

Discharge measurements of North Platte River at Guernsey, Wyo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	J. M. Giles	193	399	1.30	1,020
March 25	do	310	1,340	4.00	7,850
March 26	do	310	1,260	3.85	7,270
April 12	do	309	758	2.37	2,910
1908.					
May 26	U. S. Reclamation Service			3.20	5,810
June 10	do				6,040
June 17	do			5.70	6,990
June 18	W. B. Freeman	308	1,500	5.60	6,590
June 19	do	308	1,500	5.60	6,500
July 2	U. S. Reclamation Service			3.20	2,400
July 6	do			3.90	3,600
July 20	do			2.90	1,950
August 18	do			2.90	1,530
September 18	do			1.90	530
October 6	do			1.90	565
October 14	do			2.00	556

NOTE.—Beginning with measurement of June 17, 1908, gage heights refer to new gage, the datum of which is 1 foot lower than that of old gage.

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Daily gage height, in feet, of North Platte River at Guernsey, Wyo., for 1907 and 1908.

[W. F. Peterson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	1.00	.....	.....	2.65	2.50	5.85	5.70	2.60	1.00	0.92	0.80	2.20
2	.90	.....	.....	2.45	2.60	5.80	5.60	2.58	1.00	.82	.80	2.20
3	.95	.....	.....	2.35	2.67	5.72	5.55	2.45	1.00	.80	.80	2.18
4	.65	.....	.....	2.30	2.72	5.85	5.50	2.35	1.00	.80	.80	2.15
5	.75	.....	1.30	2.30	2.62	6.00	5.50	2.28	1.00	.80	.85	2.12
6	.85	.....	1.30	2.30	2.55	6.10	5.50	2.15	1.00	.80	.90	2.10
7	1.00	.....	1.35	2.30	2.50	6.15	5.40	1.90	1.00	.80	.95	2.10
8	.85	.....	1.50	2.30	2.45	6.40	5.35	1.88	.95	.80	1.00	2.10
9	1.00	.....	1.50	2.40	2.32	6.50	5.30	1.80	.95	.85	1.05	2.10
10	1.00	.....	1.50	2.40	2.30	6.90	5.00	1.68	1.00	.85	1.10	2.10
11	1.00	.....	1.50	2.40	2.30	7.00	4.85	1.60	1.00	.90	1.10	2.10
12	1.00	.....	1.50	2.37	2.25	6.88	4.75	1.58	1.00	.90	1.20	2.00
13	1.00	.....	1.52	2.32	2.42	6.75	4.62	1.50	1.00	.95	1.20	2.00
14	1.00	.....	1.50	2.30	2.55	6.45	4.40	1.45	1.00	.95	1.20	2.00
15	1.00	.....	1.50	2.30	2.72	6.35	4.00	1.35	1.00	1.00	1.22	2.00
16	1.00	.....	1.50	2.60	3.10	6.40	4.00	1.30	.98	1.00	1.25	2.00
17	1.00	.....	1.47	3.10	3.60	6.40	4.20	1.30	.95	1.00	1.30	1.90
18	1.10	.....	1.42	3.40	3.80	6.42	4.00	1.28	.80	1.00	1.50	1.90
19	1.00	.....	1.40	3.50	3.87	6.55	3.98	1.20	.80	1.00	1.52	1.88
20	.....	.....	1.40	3.45	3.70	6.50	3.75	1.20	.80	1.00	1.60	1.85
21	.....	.....	1.85	3.30	3.75	6.40	3.75	1.12	.80	1.00	1.65	1.85
22	.....	.....	2.30	3.25	4.05	6.32	3.35	1.08	.75	1.00	1.80	1.80
23	.....	.....	2.80	3.15	4.52	6.30	3.15	1.00	.75	1.00	1.80	1.80
24	.....	.....	3.70	2.85	4.95	6.25	3.05	1.00	.75	1.00	1.85	1.80
25	.....	.....	4.10	2.70	5.40	6.20	3.10	1.00	.75	1.00	1.88	1.80
26	.....	.....	3.80	2.70	5.90	6.15	2.85	1.00	.80	1.00	1.90	1.80
27	.....	.....	3.45	2.60	6.15	6.00	2.75	1.00	.90	.95	2.00	1.85
28	.....	.....	3.10	2.60	6.12	5.90	2.62	1.00	1.00	.92	2.00	1.82
29	.....	.....	2.95	2.50	6.00	5.85	2.50	1.00	1.00	.90	2.25	1.80
30	.....	.....	2.90	2.50	6.00	5.70	2.55	1.55	1.00	.85	2.30	1.80
31	.....	.....	2.80	.....	5.95	.....	2.70	1.00	.....	.80	.....	1.80
1908.[a]												
1	1.8	1.8	1.2	1.15	2.0	.....	3.45	2.4	2.4	1.8	2.2	.....
2	1.8	1.8	1.2	1.0	2.0	.....	3.2	2.4	2.3	1.8	2.2	.....
3	1.8	1.8	1.15	1.0	2.0	.....	3.2	2.45	2.3	1.8	2.2	.....
4	1.8	1.8	1.0	1.0	1.9	.....	3.65	2.35	2.2	2.0	2.2	.....
5	1.8	1.8	.9	1.0	1.9	.....	4.0	2.4	2.1	1.9	2.2	.....
6	1.8	1.8	.9	1.05	1.9	.....	3.95	2.4	2.05	1.9	2.2	.....
7	1.8	1.8	.9	1.2	1.9	.....	3.9	2.4	2.0	1.9	2.2	.....
8	1.8	1.8	.8	1.05	1.9	.....	3.85	2.4	2.0	1.9	2.2	.....
9	1.8	1.8	.8	1.0	2.1	.....	3.7	2.4	2.0	2.0	2.2	.....
10	1.8	1.8	.85	1.0	2.0	.....	3.7	2.35	2.0	2.0	2.15	.....
11	1.8	1.8	.95	1.0	2.0	.....	3.65	2.2	1.95	2.0	2.1	.....
12	1.8	1.8	1.0	1.0	2.15	.....	3.55	2.2	1.9	2.0	2.0	.....
13	1.8	1.8	1.0	1.15	2.35	.....	3.45	2.25	1.9	2.0	2.0	.....
14	1.8	1.8	1.0	1.2	2.45	5.65	3.2	2.45	1.9	2.0	1.9	.....
15	1.8	1.8	1.0	1.3	2.55	5.8	3.1	2.5	1.8	2.0	1.9	.....
16	1.8	1.8	1.15	1.4	2.6	5.75	3.05	2.5	1.8	2.0	1.95	.....
17	1.8	1.8	1.2	1.4	2.5	5.7	2.95	2.7	1.8	2.0	2.0	.....
18	1.8	1.75	1.2	1.55	2.3	5.7	2.8	2.9	1.9	2.0	2.2	.....
19	1.8	1.7	1.2	1.75	2.2	5.6	2.85	2.75	1.9	2.05	2.3	.....
20	1.8	1.7	1.2	1.9	2.1	5.6	2.9	2.7	1.9	2.1	2.4	.....
21	1.8	1.7	1.2	2.0	2.0	5.6	2.8	2.7	2.0	2.1	2.4	.....
22	1.8	1.65	1.15	2.1	2.0	5.85	2.75	2.6	1.9	2.1	2.4	.....
23	1.8	1.6	1.1	2.2	2.15	6.05	2.65	2.6	1.9	2.1	2.4	.....
24	1.8	1.6	1.1	2.25	2.75	5.55	2.6	2.55	1.9	2.1	2.4	.....
25	1.8	1.6	1.05	2.3	3.45	5.45	2.5	2.7	1.9	2.15	2.4	.....
26	1.8	1.55	1.0	2.45	3.25	5.35	2.45	2.9	1.85	2.2	2.4	.....
27	1.8	1.45	1.2	2.55	3.1	5.2	2.4	2.85	1.8	2.2	2.4	.....
28	1.8	1.35	1.2	2.6	3.9	4.9	2.35	2.75	1.8	2.2	2.4	.....
29	1.8	1.2	1.25	2.35	5.5	4.55	2.3	2.6	1.8	2.2	2.4	.....
30	1.8	.....	1.25	2.2	5.3	4.0	2.35	2.5	1.8	2.2	2.4	.....
31	1.8	.....	1.3	.....	.....	.....	2.4	2.4	.....	2.2	.....	.....

[a] Gage washed out June 1, 1908, by high water that reached a maximum gage height of 11.5 feet on June 2 or 3, 1908. New gage installed June 14, 1908.

NOTE.—Probable ice conditions existed January 1 to March 4, 1907, November 16, 1907, to March 1, 1908, and after November 17, 1908. On February 1, 1908, the ice was 14 inches thick.

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Rating tables for North Platte River at Guernsey, Wyo.

MARCH 5 TO MAY 22, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	1,020	2.10	2,340	2.90	4,200	3.70	6,720
1.40	1,100	2.20	2,540	3.00	4,480	3.80	7,080
1.50	1,310	2.30	2,750	3.10	4,770	3.90	7,460
1.60	1,460	2.40	2,970	3.20	5,070	4.00	7,850
1.70	1,620	2.50	3,200	3.30	5,380	4.10	8,250
1.80	1,790	2.60	3,440	3.40	5,700		
1.90	1,970	2.70	3,690	3.50	6,030		
2.00	2,150	2.80	3,940	3.60	6,370		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and one made in 1906 and is well defined between gage heights 1.3 feet and 4.1 feet.

MAY 23 TO NOVEMBER 17, 1907.

0.70	750	2.00	2,550	3.30	5,180	5.20	10,100
.80	850	2.10	2,730	3.40	5,410	5.40	10,740
.90	960	2.20	2,920	3.50	5,650	5.60	11,320
1.00	1,080	2.30	3,110	3.60	5,890	5.80	11,900
1.10	1,200	2.40	3,300	3.70	6,130	6.00	12,500
1.20	1,330	2.50	3,500	3.80	6,380	6.20	13,100
1.30	1,460	2.60	3,700	3.90	6,640	6.40	13,700
1.40	1,600	2.70	3,900	4.00	6,900	6.60	14,300
1.50	1,750	2.80	4,100	4.20	7,420	6.80	14,920
1.60	1,900	2.90	4,310	4.40	7,950	7.00	15,550
1.70	2,060	3.00	4,520	4.60	8,490		
1.80	2,220	3.10	4,730	4.80	9,030		
1.90	2,380	3.20	4,950	5.00	9,590		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is developed from the form of the curve used in the latter part of 1906 and the relation of the curves in the first part of the year to the latter part. It is not well defined, but is probably a fairly close approximation. No discharge measurements were made during this period.

MARCH 1 TO MAY 31, 1908.

0.80	730	1.90	2,440	3.00	5,170	4.20	9,560
.90	850	2.00	2,650	3.10	5,480	4.40	10,440
1.00	980	2.10	2,860	3.20	5,800	4.60	11,320
1.10	1,110	2.20	3,080	3.30	6,130	4.80	12,200
1.20	1,250	2.30	3,310	3.40	6,470	5.00	13,100
1.30	1,390	2.40	3,550	3.50	6,820	5.20	14,000
1.40	1,540	2.50	3,800	3.60	7,180	5.40	14,900
1.50	1,700	2.60	4,060	3.70	7,550	5.60	15,800
1.60	1,870	2.70	4,330	3.80	7,930		
1.70	2,050	2.80	4,600	3.90	8,320		
1.80	2,240	2.90	4,880	4.00	8,720		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the form of the curve used in the earlier part of 1907 and is not well defined.

JUNE 14 TO JULY 24, 1908.

2.60	1,570	3.40	2,670	4.20	4,000	5.60	5,470
2.70	1,690	3.50	2,830	4.30	4,180	5.20	5,850
2.80	1,820	3.60	2,990	4.40	4,360	5.40	6,250
2.90	1,950	3.70	3,150	4.50	4,540	5.60	6,670
3.00	2,080	3.80	3,310	4.60	4,720	5.80	7,090
3.10	2,220	3.90	3,480	4.70	4,900	6.00	7,510
3.20	2,370	4.00	3,650	4.80	5,090		
3.30	2,520	4.10	3,820	4.90	5,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during this period, and is fairly well defined.

JULY 25 TO AUGUST 14, 1908.

[Indirect method for shifting channels used.]

AUGUST 15 TO NOVEMBER 17, 1908.

1.80	500	2.10	650	2.40	940	2.70	1,280
1.90	540	2.20	740	2.50	1,050	2.80	1,400
2.00	580	2.30	840	2.60	1,160	2.90	1,530

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is not well defined.

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Daily discharge, in second-feet, of North Platte River at Guernsey, Wyo., for 1908.

Day.	July.	Aug.	Day.	July.	Aug.	Day.	July.	Aug.
1		1,120	11		840	21		
2		1,120	12		840	22		
3		1,180	13		890	23		
4		1,060	14		1,100	24		
5		1,120	15			25	1,350	
6		1,120	16			26	1,290	
7		1,120	17			27	1,230	
8		1,040	18			28	1,170	
9		1,040	19			29	1,110	
10		990	20			30	1,170	
						31	1,230	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Platte River at Guernsey, Wyo., for 1907 and 1908.

[Drainage area, 16,200 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 5–31	8,250	1,020	2,720	0.168	0.17	146,000	B.
April	6,030	2,750	3,650	.225	.25	217,000	B.
May	13,000	2,640	6,430	.397	.46	395,000	B.
June	15,200	11,600	13,300	.821	.92	791,000	C.
July	11,600	3,500	7,510	.464	.53	462,000	B.
August	3,700	1,080	1,850	.114	.13	114,000	C.
September	1,080	800	994	.061	.07	59,100	D.
October	1,080	850	981	.061	.07	60,300	D.
November 1–16	1,400	850	1,100	.068	.04	34,900	D.
The period						2,230,000	
1908.							
March	1,390	730	1,090	.067	.08	67,000	B.
April	4,060	980	1,960	.121	.14	117,000	B.
May	17,000	2,440	4,690	.289	.33	288,000	C.
June	30,000	3,650	10,500	.648	.72	625,000	D.
July	3,650	1,110	2,240	.138	.16	138,000	B.
August	1,530	840	1,150	.071	.08	70,700	B.
September	940	500	583	.036	.04	34,700	B.
October	740	500	614	.038	.04	37,800	B.
November 1–17	740	540	670	.041	.03	22,600	B.
The period						1,400,000	

NOTE.—Discharges May 31 to June 13, 1908, interpolated. These interpolations are based on an estimated flood discharge of 30,000 second-feet on June 3 and the measurement made on June 10, 1908.

NORTH PLATTE RIVER NEAR MITCHELL, NEBR.

This station, which was established June 3, 1901, to replace the station at Gering, is located at a highway bridge 1 mile south of Mitchell, Nebr., in sec. 27, T. 23 N., R. 56 W. The records at this point show the amount of water passing the Wyoming-Nebraska state line, and are of especial value in connection with interstate questions concerning the distribution of water. Laramie River and Rawhide Creek enter the river in Wyoming below the Guernsey station, and Horse Creek comes in just below the state line. No important tributaries enter below the station. Important diversions for irrigation are made both above and below the station.

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The datum of the gage was lowered 1 foot May 3, 1902, to obviate negative readings. As the river sometimes freezes solid, few records have been obtained during the winter.

As the bed of the river is of shifting sand, and the measurements are insufficient in number to indicate all changes, the results obtained are unsatisfactory.

Discharge measurements of North Platte River near Mitchell, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 5	Arthur Dobson	999	1,460	3.50	3,680
May 23	A. R. Dobson	1,040	2,270	4.02	7,040
June 14	Arthur Dobson	1,050	3,780	5.25	13,800
July 17	do	998	2,030	3.90	6,000
August 28	do	814	600	2.65	1,300
September 19	do	638	337	2.42	726
October 23	Adna Dobson	669	411	2.45	844
1908.					
February 27	Adna Dobson	592	505	2.53	904
March 16	do	738	494	2.35	956
April 23	G. W. Bates	875	653	2.50	1,330
June 1	Adna Dobson	1,020	3,980	5.35	16,800
June 16	Arthur Dobson	1,030	2,250	4.02	7,340
July 10	do	972	1,170	2.89	2,805
July 28	do	700	425	2.35	866
August 29	do	762	510	2.40	992
September 17	Adna Dobson	180	65	1.60	61
October 30	do	462	201	1.98	305
November 19	G. W. Bates	588	410	2.27	766
Do	do	610	404	2.25	732
December 31[a]	L. F. Flower	694	449	2.34	509

[a] Slush ice affected discharge measurement.

Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1907 and 1908.

[B. H. Newbold, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		3.7	3.3	5.0	4.8	3.3		2.6	2.4	
2		3.6	3.4		4.7	3.3	2.7	2.5	2.4	2.3
3		3.6	3.4	5.0	4.7	3.3	2.6	2.5		2.3
4		3.5	3.4	4.9	4.7		2.6	2.4	2.4	2.3
5		3.5		5.0	4.6	3.2	2.6	2.4	2.4	2.3
6		3.5	3.4	5.0	4.6	3.1	2.6		2.4	2.4
7		3.5	3.3	5.1		3.0	2.6	2.4	2.4	2.4
8		3.5	3.3	5.2	4.5	3.0		2.4	2.4	
9		3.5	3.3		4.6	3.0	2.6	2.4	2.4	2.4
10		3.4	3.3	5.3	4.6	3.0	2.6	2.4		2.4
11		3.4	3.3	5.5	4.5		2.6	2.4	2.4	2.4
12		3.4		5.5	4.4	3.0	2.6	2.4	2.4	2.4
13		3.4	3.3	5.5	4.3	2.9	2.5		2.4	2.4
14			3.3	5.2		2.9	2.5	2.4	2.4	2.4
15		3.3	3.3	5.1	4.3	2.8		2.4	2.4	
16		3.4	3.4		4.1	2.8	2.5	2.4	2.4	
17		3.5	3.5	5.0	3.9	2.8	2.5	2.4		
18		3.6	3.8	4.9	3.8		2.4	2.4	2.4	
19		3.6		4.9	3.9	2.7	2.4	2.4	2.4	
20		3.7	3.9	4.8	3.9	2.7	2.4		2.4	
21			3.9	4.8		2.7	2.4	2.4	2.4	
22		3.8	3.9	4.8	3.7	2.7		2.4	2.4	
23		3.8	4.0		3.7	2.7	2.4	2.4	2.4	
24		3.7	4.4	4.8	3.5	2.7	2.4	2.4		
25		3.5	4.5	4.8	3.5		2.4	2.4	2.4	
26		3.4		4.8	3.5	2.7	2.4	2.4	2.4	
27		3.4	5.1	4.9	3.5	2.7	2.4		2.4	
28			5.2	4.9		2.7	2.4	2.4	2.4	
29		3.3	5.1	4.8	3.4	2.7		2.4	2.3	
30		3.3	5.1		3.3	2.6	2.5	2.4	2.3	
31			5.0		3.3	2.7		2.4		

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Daily gage height, in feet, of North Platte River near Mitchell, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	.....	2.5	2.7	5.1	3.4	2.3	2.2	1.5	.....	2.4
2	2.25	2.5	2.7	6.0	3.0	.....	2.1	1.5	2.2	2.4
3	2.25	2.5	.....	5.0	2.9	2.4	2.1	1.5	2.3	2.5
4	2.25	2.5	2.6	5.8	2.8	2.4	2.1	.....	2.3	2.7
5	2.35	.....	2.7	4.4	.....	2.4	2.1	1.5	2.3	2.8
6	2.55	2.5	2.6	4.2	3.1	2.3	.....	1.5	2.3	.....
7	2.55	2.5	2.6	.....	3.1	2.4	2.1	1.5	2.3	2.8
8	.....	2.5	2.6	4.0	3.0	2.4	2.1	1.5	.....	2.7
9	2.25	2.5	2.5	3.9	3.0	.....	2.0	1.5	2.3	2.5
10	2.25	2.4	.....	3.9	3.0	2.3	2 0	1.5	2.4	2.4
11	2.25	2.4	2.6	3.8	2.9	2.3	2.0	.....	2.4	2.4
12	2.25	.....	2.7	3.7	.....	2.3	2.0	1.5	2.4	2.4
13	2.35	2.3	2.8	3.7	3.1	2.2	.....	1.6	2.3	.....
14	2.35	2.3	2.8	.....	2.9	2.3	2.0	1.7	2.4	2.4
15	.....	2.3	2.8	3.8	2.8	2.3	1.9	1.7	.....	2.5
16	2.35	2.2	2.9	3.8	2.8	.....	1.9	1.7	2.5	2.5
17	2.2	2.2	.....	3.7	2.8	2.2	1.6	1.7	2.7	2.5
18	2.3	2.2	3.0	3.8	2.7	2.2	1.6	.....	2.8	2.4
19	2.3	.....	2.9	3.9	.....	2.3	1.5	1.7	2.3	2.4
20	2.3	2.3	2.8	3.9	2.6	2.3	.....	1.8	2.3	.....
21	2.4	2.3	2.7	.....	2.5	2.3	1.5	1.9	2.4	2.4
22	.....	2.4	2.7	3.8	2.7	2.3	1.5	1.9	.....	2.4
23	2.4	2.4	2.7	3.8	2.6	.....	1.5	2.0	2.5	2.5
24	2.4	2.5	.....	3.9	2.5	2.3	1.5	2.0	2.5	2.5
25	2.5	2.6	3.0	3.8	2.5	2.3	1.4	.....	2.5	2.5
26	2.4	.....	3.5	3.7	.....	2.3	1.4	2.0	2.4	2.6
27	2.4	2.7	3.4	3.7	2.5	2.3	.....	1.9	2.3	.....
28	2.4	2.9	3.4	.....	2.4	2.3	1.4	1.9	2.3	2.6
29	.....	3.0	4.05	3.6	2.3	2.4	1.5	1.8	.....	2.5
30	2.4	2.8	4.7	3.6	2.3	.....	1.5	1.8	2.3	2.4
31	2.5	.....	.....	.....	2.3	2.3	.....	1.8	.....	2.4

Rating tables for North Platte River near Mitchell, Nebr.

APRIL 1 TO MAY 26, 1907.

[Daily discharges were obtained by the indirect method for shifting channels.]

MAY 27 TO DECEMBER 14, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	600	3.20	2,930	4.10	7,070	5.00	12,270
2.40	760	3.30	3,310	4.20	7,610	5.10	12,890
2.50	930	3.40	3,700	4.30	8,160	5.20	13,510
2.60	1,130	3.50	4,120	4.40	8,720	5.30	14,140
2.70	1,360	3.60	4,570	4.50	9,290	5.40	14,770
2.80	1,620	3.70	5,030	4.60	9,880	5.50	15,400
2.90	1,910	3.80	5,510	4.70	10,470		
3.00	2,230	3.90	6,010	4.80	11,060		
3.10	2,570	4.00	6,540	4.90	11,660		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during this period and the form of the 1906 curve, and is well defined between gage heights 2.4 feet and 5.25 feet.

MARCH 2 TO DECEMBER 31, 1908.

1.40	25	2.60	1,510	3.80	6,100	5.00	13,900
1.50	40	2.70	1,780	3.90	6,670	5.10	14,700
1.60	61	2.80	2,070	4.00	7,200	5.20	15,520
1.70	90	2.90	2,380	4.10	7,750	5.30	16,360
1.80	130	3.00	2,700	4.20	8,330	5.40	17,220
1.90	210	3.10	3,050	4.30	8,940	5.50	18,100
2.00	330	3.20	3,430	4.40	9,570	5.60	19,000
2.10	470	3.30	3,830	4.50	10,230	5.70	20,000
2.20	630	3.40	4,250	4.60	10,930	5.80	21,000
2.30	810	3.50	4,700	4.70	11,650	5.90	22,000
2.40	1,020	3.60	5,170	4.80	12,380	6.00	23,000
2.50	1,260	3.70	5,660	4.90	13,130		

NOTE.—The above table is not applicable for ice conditions. It is based on 12 discharge measurements made during this period and is not well defined above gage height 4.0 feet.

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Daily discharge, in second-feet, of North Platte River near Mitchell, Nebr., for 1907.

Day.	Apr.	May.	Day.	Apr.	May.	Day.	Apr.	May.
1	4,600	3,300	11	3,400	3,400	21	5,200	6,350
2	4,100	3,700	12	3,450	3,400	22	5,400	6,350
3	4,100	3,700	13	3,450	3,450	23	5,400	6,850
4	3,700	3,800	14	3,250	3,450	24	4,900	9,000
5	3,750	3,800	15	3,050	3,450	25	4,000	9,600
6	3,800	3,800	16	3,500	3,900	26	3,600	10,200
7	3,800	3,400	17	3,950	4,300	27	3,600	.....
8	3,800	3,400	18	4,400	5,750	28	3,500	.....
9	3,800	3,400	19	4,400	6,000	29	3,300	.....
10	3,400	3,400	20	4,900	6,300	30	3,300	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Platte River near Mitchell, Nebr., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	5,400	3,050	3,960	236,000	B.
May	13,500	3,300	6,190	381,000	B.
June	15,400	11,100	12,400	738,000	B.
July	11,100	3,310	7,110	437,000	B.
August	3,310	1,130	1,920	118,000	B.
September	1,360	760	960	57,100	B.
October	1,130	760	783	48,100	B.
November	760	600	749	44,600	B.
December 1–14	760	600	703	19,500	B.
The period				2,080,000	
1908.					
March	1,380	630	931	57,200	C.
April	2,700	630	1,210	72,000	B.
May	12,700	1,260	2,980	183,000	B.
June	23,000	5,170	7,950	473,000	B.
July	4,250	810	2,030	125,000	B.
August	1,020	630	815	50,100	B.
September	630	25	229	13,600	C.
October	330	40	121	7,440	D.
November	1,260	330	898	53,400	B.
December	1,020	510	859	52,800	D.
The period				1,090,000	

NOTE.—Discharge was interpolated for days on which gage was not read.

NORTH PLATTE RIVER AT NORTH PLATTE, NEBR.

This station, which was established October 5, 1894, to determine the amount of water below all diversions contributed by the North Platte to the Platte, is located 3½ miles above the junction of North and South Platte rivers at a highway bridge about one-half mile north of the city of North Platte, in sec. 28, T. 14 N., R. 30 W. The gage is at the Union Pacific Railway bridge, 2 miles below.

Many diversions are made between this point and the Mitchell station. One small tributary, Birchwood Creek, maintains a small flow of water at the gaging station at times when the river itself would otherwise be dry.

The drainage area is 28,500 square miles.

During the winter the river often freezes solid, as it is very shallow. Records at this station are subject to the same limitations of shifting

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channel and poor measuring conditions as other stations on the river, though to a somewhat less degree.

The datum of the gage has remained unchanged since the station was established.

Discharge measurements of North Platte River at North Platte, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 4	Arthur Dobson	1,720	2,260	2.65	5,830
May 24	A. R. Dobson	1,940	2,890	2.88	7,910
June 16	Arthur Dobson	1,970	4,710	3.70	16,000
July 16	do	1,940	3,190	3.35	9,270
September 1	do	408	772	1.80	1,500
September 21	do	355	493	1.65	1,020
November 8	Adna Dobson	1,080	670	2.00	1,400
1908.					
March 5	G. W. Bates	1,100	950	2.25	1,860
April 24	do	1,010	704	2.10	1,580
June 2	Adna Dobson	1,900	5,010	3.85	14,000
June 17	Arthur Dobson	1,810	2,830	3.20	7,330
July 12	do	1,050	1,160	2.60	2,960
July 29	do	665	490	1.80	1,050
August 30	do	512	283	1.85	553
September 16	Adna Dobson	150	124	1.42	206
October 31	A. A. Dobson	650	588	2.05	1,150
November 21	G. W. Bates	1,020	1,160	2.30	2,590

Daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1907 and 1908.

[Henry Deck and C. P. Miller, observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.[a]										
1			2.38	3.40	3.32	2.30	1.95	2.25	1.80	1.80
2			2.40	3.40	3.30	2.40	2.10	2.10	1.80	1.80
3		2.60	2.48	3.40	3.30	2.45	2.00	2.10	1.80	1.80
4		2.60	2.50	3.40	3.30	2.40	2.00	2.10	1.80	1.80
5		2.60	2.42	3.40	3.30	2.30	1.90	2.00	1.82	1.90
6		2.60	2.38	3.30	3.30	2.20	1.85	1.90	1.88	1.90
7		2.58	2.30	3.30	3.30	2.10	1.80	1.90	1.88	1.90
8		2.55	2.35	3.30	3.25	2.10	1.80	1.85	1.90	1.95
9		2.50	2.40	3.40	3.25	2.10	1.78	1.82	2.00	1.95
10		2.45	2.40	3.50	3.22	2.00	1.75	1.80	2.00	2.00
11		2.45	2.38	3.40	3.18	1.90	1.75	1.80	2.00	2.00
12		2.40	2.30	3.40	3.15	1.88	1.72	1.80	2.00	2.00
13		2.35	2.20	3.60	3.00	1.86	1.70	1.80	2.05	2.00
14		2.40	2.20	3.60	3.00	1.85	1.70	1.80	2.15	2.00
15		2.35	2.20	3.60	3.00	1.85	1.70	1.80	2.20	.....
16		2.35	2.20	3.60	3.00	1.85	1.70	1.80	2.20	.....
17		2.38	2.20	3.40	3.00	1.85	1.70	1.80	2.30	.....
18		2.35	2.20	3.35	2.95	1.85	1.70	1.80	2.30	.....
19		2.35	2.20	3.25	2.90	1.85	1.70	1.80	2.25	.....
20		2.35	2.25	3.15	2.88	1.85	1.70	1.80	2.20	.....
21		2.52	2.58	3.10	2.80	1.85	1.70	1.80	2.15	.....
22		2.55	2.78	3.15	2.70	1.85	1.65	1.80	2.05	.....
23		2.60	2.82	3.25	2.65	1.85	1.65	1.85	2.00	.....
24		2.60	2.90	3.30	2.62	1.85	1.60	1.85	2.00	.....
25		2.60	2.95	3.32	2.60	1.85	1.60	1.90	2.00	.....
26		2.62	2.90	3.55	2.48	1.85	1.65	1.85	2.00	.....
27		2.58	2.90	3.60	2.45	1.85	1.80	1.85	2.00	.....
28		2.52	2.95	3.60	2.42	1.88	1.85	1.85	1.90	.....
29		2.42	3.20	3.55	2.40	2.02	1.95	1.82	1.90	.....
30		2.40	3.42	3.38	2.35	2.05	2.10	1.80	1.90	.....
31		.....	3.40	.....	2.30	2.00	.....	1.80	.....	.....

[a] Ice conditions after November 13, 1907.

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Daily gage height, in feet, of North Platte River at North Platte, Nebr., for 1907 and 1908— Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.[a]										
1	2.	2.2	2.1	4.1	2.9	1.7	1.7	1.45	1.9	1.8
2	2.2	2.2	2.25	4.1	2.9	1.7	1.7	1.4	1.95	1.8
3	2.25	2.1	2.3	4.0	2.85	1.6	1.7	1.4	2.0	1.8
4	2.3	2.1	2.4	4.7	2.0	1.5	1.6	1.35	2.0	1.8
5	2.3	2.1	2.5	4.5	2.0	1.5	1.6	1.35	2.0	1.8
6	2.3	2.1	2.6	4.55	2.3	1.5	1.4	1.35	2.0	1.8
7	2.3	2.2	2.5	3.6	2.2	1.5	1.35	1.4	2.0	1.8
8	2.25	2.2	2.5	3.2	2.0	1.7	1.3	1.45	2.0	1.8
9	2.2	2.1	2.45	3.1	2.0	1.6	1.2	1.55	2.0	1.8
10	2.05	2.1	2.4	3.0	2.0	1.6	1.2	1.6	2.0	1.8
11	2.25	2.1	2.4	3.0	2.0	1.6	1.3	1.6	2.0	1.9
12	2.4	2.1	2.5	3.0	2.4	1.6	1.3	1.6	2.6	1.9
13	2.3	2.1	2.6	3.25	2.5	1.6	1.3	1.6	2.3	2.0
14	2.3	2.1	2.7	3.0	2.5	1.6	1.4	1.6	2.1	2.0
15	2.1	2.1	2.6	3.0	2.2	1.6	1.4	1.6	2.0	2.0
16	1.9	2.1	2.4	3.0	2.2	1.6	1.4	1.6	2.0	2.1
17	1.9	2.1	[b]	3.05	2.1	1.6	1.4	1.55	2.0	2.1
18	1.9	2.1	[b]	3.35	2.0	1.6	1.4	1.55	2.1	2.2
19	2.1	2.1	[b]	3.0	2.0	1.6	1.4	2.5	2.3	2.3
20	2.25	2.1	[b]	3.0	2.0	1.9	1.5	2.6	2.4	2.3
21	2.2	2.1	3.4	3.0	2.0	1.9	1.4	2.6	2.5	2.4
22	2.05	2.1	3.4	2.85	2.0	1.8	1.4	2.35	2.6	2.4
23	2.1	2.1	3.65	3.15	1.9	1.8	1.4	2.15	2.5	2.4
24	2.1	1.9	3.6	3.0	1.9	1.8	1.4	2.1	2.4	2.4
25	2.1	1.9	3.6	3.35	1.9	1.8	1.4	1.95	2.3	2.4
26	2.1	2.0	3.6	3.0	1.8	2.0	1.4	1.9	2.2	2.4
27	2.15	2.1	3.6	3.0	1.75	2.0	1.3	1.8	2.1	2.4
28	2.2	2.1	3.6	3.2	1.8	2.0	1.3	1.8	2.0	2.4
29	2.2	2.1	3.6	3.0	1.8	2.0	1.4	1.9	1.9	2.4
30	2.2	2.2	3.6	3.0	1.8	1.8	1.4	1.9	1.85	2.4
31	2.2	.....	3.7	.....	1.8	1.8	.....	1.85	.....	2.4

[a] Gage heights for August and September, 1908, uncertain. [b] High water May 17–20, 1908, no readings.

Daily discharge, in second-feet, of North Platte River at North Platte, Nebr., for 1907 and 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	.....	4,200	12,800	10,600	2,900	2,100	3,600	800	800
2	.....	.....	4,350	12,800	10,300	3,500	2,800	2,800	800	800
3	.....	5,500	4,900	12,800	10,200	3,800	2,350	2,800	800	800
4	.....	5,500	5,000	12,800	10,100	3,600	2,350	2,800	800	800
5	.....	5,500	4,500	12,800	10,000	3,100	1,900	2,300	850	1,100
6	.....	5,500	4,300	11,800	9,900	2,600	1,700	1,600	1,000	1,100
7	.....	5,350	3,800	11,800	9,800	2,200	1,500	1,600	1,000	1,100
8	.....	5,150	4,100	11,800	9,200	2,200	1,500	1,450	1,100	1,100
9	.....	4,800	4,400	12,800	9,100	2,250	1,450	1,400	1,400	1,100
10	.....	4,500	4,400	13,800	8,800	1,900	1,300	1,300	1,400	1,100
11	.....	4,500	4,300	12,800	8,350	1,500	1,300	1,300	1,400	1,100
12	.....	4,200	3,800	12,800	8,000	1,450	1,250	1,300	1,400	1,100
13	.....	4,000	3,350	14,900	6,700	1,350	1,200	1,300	1,400	1,100
14	.....	4,300	3,350	14,900	6,650	1,400	1,200	1,100	1,400	1,100
15	.....	4,000	3,350	14,900	6,500	1,400	1,200	1,100	1,400	.....
16	.....	4,000	3,350	14,900	6,400	1,400	1,200	1,100	1,400	.....
17	.....	4,150	3,350	12,800	6,500	1,500	1,200	1,100	1,400	.....
18	.....	4,000	3,350	12,300	6,200	1,500	1,200	1,100	1,400	.....
19	.....	4,000	3,350	11,200	5,900	1,500	1,200	1,100	1,400	.....
20	.....	4,000	3,600	10,100	5,800	1,500	1,200	1,100	1,400	.....
21	.....	5,000	5,600	9,650	5,300	1,500	1,200	1,100	1,400	.....
22	.....	5,200	7,100	10,000	4,800	1,500	1,000	1,000	1,400	.....
23	.....	5,600	7,400	10,600	4,500	1,600	1,000	1,100	1,400	.....
24	.....	5,600	8,100	11,100	4,300	1,600	900	1,100	1,400	.....
25	.....	5,600	8,500	11,200	4,300	1,600	900	1,300	1,400	.....
26	.....	5,800	8,100	13,500	3,600	1,600	1,000	1,100	1,400	.....
27	.....	5,500	8,100	13,900	3,500	1,650	1,500	1,100	1,400	.....
28	.....	5,100	8,500	13,800	3,400	1,750	1,700	1,100	1,100	.....
29	.....	4,500	10,800	13,200	3,350	2,400	2,100	1,050	1,100	.....
30	.....	4,350	13,000	11,300	3,100	2,600	2,800	800	1,100	.....
31	.....	.....	12,800	.....	2,900	2,300	.....	800	.....	.....

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Daily discharge, in second-feet, of North Platte River at North Platte, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	1,670	1,820	1,440	17,100	4,900	780	320	220	740	780
2	1,670	1,820	2,000	17,100	4,900	780	320	180	850	780
3	1,860	1,450	2,240	15,900	4,500	460	380	160	990	780
4	2,080	1,450	2,700	25,500	750	310	270	130	1,100	780
5	2,080	1,450	3,270	22,600	750	310	270	130	1,100	780
6	2,080	1,450	3,850	23,300	1,650	310	140	130	1,100	670
7	2,080	1,820	3,270	11,200	1,250	310	140	160	1,100	670
8	1,860	1,820	3,270	7,300	700	630	120	180	1,100	670
9	1,670	1,450	3,000	6,550	700	460	70	250	1,160	670
10	1,150	1,450	2,700	5,800	700	460	70	300	1,160	670
11	1,860	1,580	2,450	5,800	700	360	130	300	1,160	.....
12	2,550	1,580	3,100	5,800	2,000	360	130	300	4,000	.....
13	2,080	1,580	3,700	7,800	2,450	360	130	300	2,300	.....
14	2,080	1,580	4,300	5,800	2,450	360	190	300	1,600	.....
15	1,300	1,580	3,700	5,800	1,530	360	200	270	270	.....
16	750	1,580	2,450	5,800	1,530	360	200	270	1,250	.....
17	750	1,580	.....	6,200	1,180	360	200	240	1,250	.....
18	850	1,580	.....	8,700	1,120	360	200	240	1,600	.....
19	1,450	1,580	.....	5,800	1,120	270	200	3,200	2,600	.....
20	2,030	1,580	.....	5,800	1,120	780	270	3,800	3,150	.....
21	1,830	1,580	9,400	5,800	1,120	780	200	3,800	3,750	.....
22	1,280	1,580	9,400	4,550	1,120	570	180	2,350	4,400	.....
23	1,450	1,580	12,000	7,000	1,070	570	180	1,520	3,750	.....
24	1,450	940	11,500	5,600	1,070	570	180	1,350	3,150	.....
25	1,450	940	11,500	8,450	1,070	570	180	900	2,600	.....
26	1,450	1,230	11,500	5,600	800	1,050	180	740	2,130	.....
27	1,630	1,580	11,500	5,600	900	860	150	530	1,720	.....
28	1,820	1,580	11,500	7,200	1,050	860	150	530	1,370	.....
29	1,820	1,580	11,500	5,600	1,050	860	180	740	1,050	.....
30	1,820	1,960	11,200	5,600	1,050	460	180	740	900	.....
31	1,820	.....	12,300	.....	1,050	460	.....	630	.....	.....

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of North Platte River near North Platte, Nebr., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April 3–30	5,800	4,000	4,830	268,000	B.
May	13,000	3,350	5,710	351,000	B.
June	14,900	9,650	12,500	744,000	B.
July	10,600	2,900	6,710	413,000	C.
August	3,800	1,350	2,020	124,000	D.
September	2,800	900	1,510	89,800	B.
October	3,600	800	1,450	89,200	D.
November	1,400	800	1,240	73,800	D.
December 1–14	1,100	800	1,010	28,000	D.
The period	.....	.....	.....	2,180,000	
1908.					
March	2,550	750	1,670	103,000	D.
April	1,960	940	1,540	91,600	C.
May (27 days)	12,300	1,440	6,320	338,000	D.
June	25,500	4,550	9,220	549,000	C.
July	4,900	700	1,530	94,100	D.
August	1,050	270	527	32,400	D.
September	380	70	190	11,300	D.
October	3,800	130	803	49,400	D.
November	4,400	740	1,850	110,000	D.
December 1–10	780	670	725	14,400	D.
The period	.....	.....	.....	1,390,000	

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PLATTE RIVER DRAINAGE BASIN.

DESCRIPTION.

From the point of junction of North and South Platte rivers the main stream winds eastward across Nebraska for over 200 miles, uniting with the Missouri at Plattsmouth, about 10 miles south of Omaha. Its course lies chiefly through broad, level bottom lands, rather sandy in places, but for the most part fertile, bordered by bluffs varying in height from 50 to 300 or 400 feet. From its source to a point near Ashland, Saunders County, it is a broad, shallow stream, flowing in many places as a network of interlacing channels among numerous islands and sand bars, but farther east it is confined between heavily wooded limestone bluffs. The average fall is about 6 feet per mile.

The average annual precipitation is about 23 inches, of which 69 per cent falls during the five months of the growing season, from April to August and about one-half of the remainder is snowfall. The evaporation averages about 4½ feet. The stream is subject to periodic floods caused by melting of snows in the headwaters regions of North and South Platte rivers. These floods reach a maximum in June and July and often do considerable damage to property on the lower portions of the stream. In the western part of the drainage area the waters of the stream are extensively used for irrigation.

The Loup and its branches, which form the most important tributaries of the Platte below the forks, drain an area 13,540 square miles in extent, lying in the heart of Nebraska. The Loup proper is formed by the junction of North and Middle Loup rivers, which unite near the city of St. Paul, the middle Loup in turn receiving the South Loup in the southwestern part of Howard County. The principal tributaries are Beaver, Cedar, Calamus, and Dismal creeks. A comparatively small amount of water is diverted for irrigation, the ditches generally being small and covering limited areas. A number of power plants are in operation and others of considerable extent have been proposed, particularly one near Columbus, by which it is believed that about 20,000 continuous horsepower may be developed.

The records of the Survey indicate 1905 as a year of high water, and 1902 and 1908 as low-water years. On Loup River the flow was probably lowest in 1895.

The following gaging stations have been maintained in this section of the Platte basin:

Platte River near Lexington, Nebr., 1902–1906.
Platte River at Columbus, Nebr., 1895–1908.
Platte River near South Bend, Nebr., 1903.
Loup River at Columbus, Nebr., 1894–1908.

31260—IRR 246—10——16

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Middle Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
North Loup River near St. Paul, Nebr., 1895, 1897, 1899, 1903.
Elkhorn River near Norfolk, Nebr., 1896–1903.
Elkhorn River near Arlington, Nebr., 1898–1903
South Fork of Elkhorn River near Norfolk, Nebr., 1896.

PLATTE RIVER AT COLUMBUS, NEBR.

This station, which was established June 4, 1895, and has been kept continuously since that date except during the winter months, is located above the mouth of Loup River, at Meridian bridge, about 3 miles south of Columbus, in sec. 31, T. 17 N., R. 1 E. No important tributaries enter the river between the junction of the North Platte and the South Platte and this station, and Loup River and Elkhorn River are the only large tributaries below. The drainage area is 56,900 square miles.

In the late summer practically all the water of the river disappears, either from diversion or evaporation from the wide shallow channels. No records have been obtained during the ice period of the winter.

The bed of the river is of shifting sand and at low water the stream flows in many shallow channels, so that determination of discharge is largely a matter of estimation. Poor measuring conditions, combined with shifting channel, render the records liable to considerable error. The gage datum has remained the same throughout.[a]

Discharge measurements of Platte River at Columbus, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of action.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 3	Arthur Dobson	2,070	2,720	3.40	6,360
May 14	F. S. Dobson	1,860	864	2.60	1,860
June 20	Arthur Dobson	2,300	5,010	4.60	14,600
July 24	....do	2,260	3,240	3.74	8,420
August 23	....do	1,000	411	1.75	758
September 14	....do	630	265	1.60	514
October 12	....do	1,510	816	2.35	1,760
November 26	G. W. Bates	1,930	1,363	2.80	2,890
1908.					
March 3	Dobson and Bates	1,750	2,320	3.66	6,660
April 20	Arthur Dobson	1,130	883	2.66	1,520
May 5	G. W. Bates	860	494	2.23	845
June 10	Arthur Dobson	2,320	5,380	4.48	13,900
July 1	....do	2,210	2,890	3.73	6,970
July 22	....do	1,550	1,540	2.97	3,210
August 22	G. W. Bates	1,180	1,050	2.70	2,130
September 12	Arthur Dobson	70	32	.....	33.4
October 10	....do	.....	.....	1.65	[b] 65.0
November 6	....do	560	456	2.30	861

[a] Data collected at this station prior to 1908 have been compiled in Water-Supply Paper 230, Surface water supply of Nebraska.
[b] Estimated.

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Daily gage height, in feet, of Platte River at Columbus, Nebr., for 1907 and 1908.

[W. D. Benson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1	.....	.....	3.2	4.25	4.25	3.0	2.6	2.8	2.5	2.65
2	.....	2.85	3.0	4.35	4.3	2.95	2.35	2.8	2.4	2.6
3	.....	3.35	3.15	4.45	4.15	2.9	2.45	2.85	2.4	2.6
4	.....	3.15	3.35	4.5	4.1	3.0	2.4	3.0	2.45	2.75
5	.....	3.40	3.1	4.5	4.05	2.95	2.3	2.8	2.3	2.75
6	.....	3.55	3.3	4.8	4.05	3.1	2.35	2.7	2.3	2.7
7	.....	3.45	3.2	4.95	4.2	3.25	2.1	2.4	2.3	2.65
8	.....	3.25	3.0	4.55	4.1	3.35	2.05	2.25	2.35	2.65
9	.....	3.1	3.0	4.35	4.2	3.15	1.9	2.35	2.25	2.55
10	.....	3.15	2.85	4.75	4.0	2.9	1.85	2.35	2.15	3.5
11	.....	2.75	3.0	5.5	4.0	3.05	1.75	2.3	2.5	.....
12	.....	2.65	3.05	4.45	4.05	2.85	1.7	2.3	2.45	.....
13	.....	2.65	2.65	4.7	4.1	3.05	1.55	2.2	.....	.....
14	.....	2.7	2.65	4.75	4.15	3.0	1.35	2.15	2.15	.....
15	.....	2.5	2.7	4.6	4.1	2.6	1.3	2.15	2.05	.....
16	.....	2.5	2.7	4.65	4.25	2.6	1.3	2.1	2.10	.....
17	.....	2.5	2.65	.....	4.4	2.55	1.2	2.2	2.2	.....
18	.....	2.65	2.5	4.85	4.45	2.4	1.25	2.3	2.4	.....
19	.....	2.7	2.55	4.85	4.0	2.25	1.25	2.45	2.5	.....
20	.....	2.85	2.6	4.55	3.85	2.05	1.1	2.35	2.6	.....
21	.....	2.9	2.65	4.35	3.65	2.0	1.1	2.3	2.65	.....
22	.....	2.85	2.65	4.2	3.55	1.95	1.1	2.35	2.7	.....
23	.....	.....	2.6	4.15	3.9	1.85	1.1	2.4	2.65	.....
24	.....	2.6	3.25	4.0	3.85	1.85	1.05	2.35	2.7	.....
25	.....	2.9	3.25	4.05	3.65	1.9	.95	2.4	2.9	.....
26	.....	3.35	3.7	4.05	3.5	1.95	.95	2.45	.....	.....
27	.....	3.25	3.9	4.05	3.6	1.5	1.4	2.45	2.8	.....
28	.....	3.25	3.65	4.0	3.65	1.65	1.6	2.5	2.7	.....
29	.....	3.35	3.8	4.2	3.55	2.3	1.65	2.5	2.6	.....
30	.....	3.4	3.85	4.25	3.4	2.0	.....	.....	2.55	.....
31	.....	.....	3.9	.....	3.15	1.95	.....	.....	.....	.....
1908.										
1	6.2	2.3	1.8	3.15	3.75	1.85	1.65	0.8	2.35	.....
2	6.25	2.3	1.75	3.2	3.95	2.0	1.6	.7	2.3	.....
3	3.65	2.45	1.55	3.1	3.8	1.95	1.5	.7	2.25	2.3
4	3.1	2.55	2.05	3.65	3.9	1.75	1.3	.7	2.25	.....
5	2.95	2.45	2.35	4.6	3.65	1.55	.....	.....	2.25	.....
6	3.0	2.4	2.6	4.75	3.8	1.6	.....	1.9	2.25	.....
7	3.0	2.55	2.7	5.95	3.9	1.5	.....	1.75	2.3	.....
8	2.3	2.65	3.0	5.85	4.2	1.4	.....	1.85	2.3	.....
9	3.0	2.45	3.0	4.8	3.8	1.4	.....	.....	2.3	.....
10	2.75	2.3	3.0	4.65	3.45	.....	.....	1.6	2.25	.....
11	2.6	2.35	3.4	4.4	3.5	1.35	.....	1.5	2.0	2.55
12	2.55	2.35	2.95	4.3	3.0	1.85	.....	1.45	1.95	2.55
13	2.5	2.5	2.9	4.3	3.0	1.9	.65	1.4	1.9	2.25
14	2.35	2.3	2.95	4.35	2.8	2.1	.75	1.3	1.95	2.85
15	2.35	2.25	2.85	4.3	.....	2.5	.8	.....	2.0	2.9
16	2.45	2.15	2.95	4.3	2.3	2.15	.8	.....	2.15	2.9
17	2.7	2.45	2.9	4.3	2.95	1.85	.8	.....	2.2	2.95
18	2.6	2.45	2.95	4.35	2.6	1.8	.8	1.3	2.2	2.95
19	2.55	2.55	3.0	4.2	2.55	2.25	.7	.....	2.3	2.85
20	2.65	2.65	3.2	4.2	2.55	2.75	.8	1.8	2.4	.....
21	2.45	2.35	3.0	4.2	2.75	2.65	.8	1.75	2.4	.....
22	2.45	2.45	2.95	4.1	2.95	2.55	.....	1.6	2.4	.....
23	2.4	2.4	2.6	4.1	3.15	2.55	.5	1.5	2.5	2.8
24	2.4	2.3	2.85	4.15	2.75	2.35	.5	1.5	2.5	2.8
25	2.4	2.2	2.95	3.9	2.6	2.3	.6	1.5	.....	2.8
26	2.3	2.15	2.95	3.9	2.85	2.2	1.3	2.6	2.95	2.8
27	2.4	2.05	3.1	3.95	2.8	2.1	1.05	2.8	2.9	2.9
28	2.4	2.1	.....	3.95	2.55	2.2	1.05	2.8	2.9	3.05
29	2.45	2.05	3.15	3.85	2.5	2.2	1.05	2.7	2.85	3.15
30	2.45	2.0	2.95	3.65	2.2	1.95	.8	2.5	2.7	3.2
31	2.45	.....	3.1	.....	2.05	1.65	.....	2.35	.....	3.25

NOTE.—Probable ice conditions January to March, 1907, December 10, 1907, March 2, 1908, December, 1908.

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Rating tables for Platte River at Columbus, Nebr.

APRIL 1 TO JULY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.50	1,600	3.30	5,500	4.10	11,150	4.90	17,300
2.60	1,900	3.40	6,150	4.20	11,900	5.00	18,100
2.70	2,300	3.50	6,850	4.30	12,650	5.10	18,900
2.80	2,750	3.60	7,550	4.40	13,400	5.20	19,700
2.90	3,200	3.70	8,250	4.50	14,150	5.30	20,500
3.00	3,700	3.80	8,950	4.60	14,900	5.40	21,300
3.10	4,250	3.90	9,650	4.70	15,700	5.50	22,100
3.20	4,850	4.00	10,400	4.80	16,500		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is fairly well defined.

AUGUST 1 TO DECEMBER 31, 1907.

0.90	50	1.60	510	2.30	1,650	3.00	3,700
1.00	80	1.70	650	2.40	1,860	3.10	4,250
1.10	125	1.80	800	2.50	2,080	3.20	4,850
1.20	175	1.90	950	2.60	2,310	3.30	5,500
1.30	235	2.00	1,100	2.70	2,570	3.40	6,150
1.40	310	2.10	1,270	2.80	2,900	3.50	6,850
1.50	400	2.20	1,460	2.90	3,280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made during this period and is well defined between gage heights 1.6 feet and 2.8 feet.

MARCH 3 TO JULY 8, 1908.

1.50	170	2.60	1,420	3.70	6,900	4.80	17,290
1.60	225	2.70	1,670	3.80	7,680	4.90	18,370
1.70	290	2.80	1,960	3.90	8,490	5.00	19,460
1.80	365	2.90	2,320	4.00	9,340	5.20	21,650
1.90	450	3.00	2,750	4.10	10,230	5.40	23,870
2.00	540	3.10	3,220	4.20	11,170	5.60	26,130
2.10	640	3.20	3,730	4.30	12,130	5.80	28,430
2.20	755	3.30	4,270	4.40	13,120	6.00	30,750
2.30	890	3.40	4,860	4.50	14,140		
2.40	1,040	3.50	5,500	4.60	15,170		
2.50	1,210	3.60	6,170	4.70	16,220		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during this period and is fairly well defined between gage heights 2.2 feet and 4.5 feet. Below gage height 2.2 feet it is very uncertain.

JULY 9 TO AUGUST 31, 1908.

1.30	200	2.00	790	2.70	2,180	3.40	5,520
1.40	255	2.10	920	2.80	2,520	3.50	6,160
1.50	320	2.20	1,060	2.90	2,900	3.60	6,840
1.60	395	2.30	1,220	3.00	3,340	3.70	7,550
1.70	475	2.40	1,400	3.10	3,830	3.80	8,300
1.80	565	2.50	1,620	3.20	4,360		
1.90	670	2.60	1,880	3.30	4,920		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during this period and the form of the preceding curve. It is not well defined.

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Monthly discharge of Platte River at Columbus, Nebr., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	7,200	1,600	3,770	224,000	B.
May	9,650	1,600	4,450	274,000	B.
June	22,100	10,400	14,000	833,000	B.
July	13,800	4,550	10,000	615,000	B.
August	5,820	400	2,500	154,000	B.
September	2,310	65	756	45,000	B.
October	3,700	1,270	1,990	122,000	B.
November	3,280	1,180	2,030	121,000	B.
December 1-14	2,740	2,200	2,430	67,500	C.
The period				2,460,000	
1908.					
March	6,540	890	1,930	119,000	C.
April	1,540	540	991	59,000	D.
May	4,860	198	2,350	144,000	C.
June	30,200	3,220	11,800	702,000	C.
July	11,200	855	4,250	261,000	C.
August	2,350	228	888	54,600	D.
The period				1,340,000	

NOTE.—There are not sufficient data for computing discharges for September to December, 1908.

LOUP RIVER AT COLUMBUS, NEBR.

This station, which was established October 13, 1894, is located at the highway bridge in the outskirts of Columbus and about 5 miles above the mouth of the river, in sec. 25, T. 17 N., R. 1 W.

The records show the total discharge of the river at its mouth, and are valuable in connection with power development. They show also the remarkably uniform flow of the stream. A comparatively small amount of water is diverted for irrigation.

Records have usually been suspended during the winter months on account of the severe ice conditions.

Measurements at this station are rough at best, owing to the soft and constantly shifting bed and the high and uneven velocity. Gage heights are only an approximate index of discharge, as the swift current changes the channel very rapidly, and at least one measurement a week would be required to give even fairly good results.

No daily discharges have been computed for 1907 and 1908, as any computation based on the data at hand would be misleading, and a fair idea of the discharge can be obtained from the discharge measurements. Two gages have been used at this station: A chain gage at the highway bridge has been used since 1904, and a staff gage at the former cable location, 1½ miles above, was used prior to that time. No changes in datum have been made.

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Discharge measurements of Loup River at Columbus, Nebr., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 3	Arthur Dobson	667	1,040	4.46	2,720
May 14	F. S. Dobson	600	948	4.40	2,850
June 20	Arthur Dobson	677	1,200	4.75	5,450
July 23	do	595	1,080	4.80	3,390
August 23	do	606	770	4.40	1,810
September 14	do	532	846	4.60	2,620
October 12	do	445	588	4.52	2,120
November 26	G. W. Bates	338	598	4.50	2,650
1908.					
March 3	Dobson and Bates	830	1,300	4.56	3,510
April 20	Arthur Dobson	866	1,210	4.74	3,140
May 5	G. W. Bates	676	843	4.58	2,840
June 7	Adna Dobson	860	2,010	5.65	9,920
June 10	Arthur Dobson	860	1,600	5.25	7,620
July 1	do	850	929	4.35	2,780
July 22	do	700	942	4.27	2,270
August 22	G. W. Bates	790	1,170	4.44	2,890
October 10	A. A. Dobson	800	1,080	4.60	2,380
November 6	do	860	850	4.45	2,580
December 29[a]	do	140	516	4.72	2,300

[a] Slush ice.

Daily gage height, in feet, of Loup River at Columbus, Nebr., for 1907 and 1908.

[W. D. Benson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1			4.4	4.7	4.6	4.55	4.7	5.2	4.9	4.8
2		4.35	4.35	4.85	4.45	4.6	4.65	5.1	4.95	4.65
3		4.45	4.45	5.0	4.45	4.6	4.6	4.9	4.5	4.85
4		4.4	4.55	4.7	4.4	4.7	4.6	4.9	4.8	4.8
5		4.5	4.55	4.85	4.4	4.55	4.65	4.7	4.7	4.75
6		4.6	4.45	4.85	4.5	4.55	4.65	4.65	4.7	4.7
7		4.55	4.4	4.9	4.7	.....	4.55	4.55	4.8	4.65
8		4.5	4.3	4.7	5.25	6.05	4.55	4.45	4.85	4.75
9		4.4	4.4	4.85	4.85	5.5	4.55	4.4	4.8	4.85
10		4.3	4.4	5.4	4.7	4.25	4.55	4.4	4.7	4.8
11		4.35	4.4	5.05	4.55	4.05	4.65	4.45	4.55	.....
12		4.25	4.45	4.9	4.5	4.05	4.65	4.6	4.4	.....
13		4.3	4.4	4.95	4.5	4.05	4.65	4.4	.....	.....
14		4.25	4.45	4.95	4.9	4.25	4.55	4.5	4.4	4.7
15		4.25	4.5	4.9	5.4	4.35	4.6	4.45	.....	.....
16		4.35	4.45	4.85	6.0	4.65	4.65	4.4	4.4	.....
17		4.45	4.65	.....	4.8	4.45	4.5	4.55	4.6	.....
18		4.55	4.65	5.1	5.2	.....	4.6	4.55	4.55	.....
19		4.45	4.6	4.7	5.35	4.25	4.6	4.55	4.5	.....
20		4.4	4.65	4.9	5.1	4.2	4.55	4.7	4.8	.....
21		4.4	4.7	4.9	5.05	4.25	4.65	4.7	4.7	.....
22		4.4	4.75	4.55	4.85	4.25	4.7	4.75	4.6	.....
23		.....	4.85	4.45	4.8	4.4	4.65	4.7	4.5	.....
24		4.4	5.55	4.45	4.85	4.45	4.6	4.7	4.55	.....
25		4.6	5.2	4.55	4.9	4.4	4.6	4.6	4.3	.....
26		4.65	5.2	4.65	4.65	4.55	4.6	4.65	.....	.....
27		4.5	5.5	4.35	4.6	4.45	4.8	4.55	4.55	.....
28		4.5	4.8	4.6	4.7	4.7	4.9	4.5	4.55	.....
29		4.6	4.85	4.75	4.7	4.75	5.0	4.5	4.6	.....
30		4.55	4.9	4.75	4.65	4.85	.....	.....	4.7	.....
31		.....	4.7	.....	4.6	4.85	.....	4.7	.....	.....

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Daily gage height, in feet, of Loup River at Columbus, Nebr., for 1907 and 1908—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
1	4.75	4.45	4.25	4.7	4.35	4.15	3.1	4.3	4.35	.....
2	5.0	4.6	4.3	5.0	4.45	3.95	4.45	4.3	4.45	4.05
3	4.4	4.55	4.3	4.45	4.65	4.05	4.25	4.25	4.45	4.05
4	4.4	4.55	4.55	4.6	4.5	4.05	4.35	4.2	4.45	4.05
5	4.4	4.5	4.95	7.2	4.4	4.0	4.25	4.5	4.45	4.6
6	.....	4.5	4.85	6.25	4.4	4.1	4.2	5.0	4.45	4.85
7	4.7	4.8	4.75	5.95	4.55	4.1	4.2	4.55	4.45	4.7
8	4.7	4.55	4.45	6.0	4.6	4.1	4.2	4.6	4.5	4.7
9	4.6	4.6	4.45	5.45	4.5	4.25	4.15	.....	4.45	4.85
10	4.55	4.6	4.4	5.2	4.3	4.3	4.15	4.5	4.45	4.85
11	4.6	4.5	4.8	4.95	4.3	4.4	4.15	4.55	4.5	4.9
12	4.6	4.7	4.5	5.5	4.35	5.1	4.15	4.6	4.5	.....
13	4.6	4.6	4.45	5.4	4.15	4.45	4.15	4.5	4.45	5.2
14	4.65	4.6	4.6	5.15	4.1	4.85	4.15	4.5	4.25	5.1
15	4.6	4.65	4.65	5.3	.....	5.3	4.15	4.5	4.25	5.05
16	4.65	4.6	4.55	4.85	4.3	5.95	4.2	4.5	4.4	4.95
17	4.4	4.85	4.75	4.85	4.25	4.6	4.2	4.5	4.45	4.8
18	4.35	4.65	4.75	5.3	4.2	4.6	4.2	4.5	4.65	4.7
19	4.55	.....	4.7	5.2	4.2	4.75	4.15	.....	4.55	4.65
20	4.4	4.75	4.6	4.85	4.25	4.4	4.25	4.6	4.5	4.45
21	4.6	4.75	4.4	4.45	4.2	4.5	4.2	4.75	4.55	4.45
22	4.45	4.7	4.35	4.55	4.2	4.75	4.25	4.65	4.55	4.35
23	4.55	4.6	4.55	6.25	4.45	4.4	4.2	4.65	4.6	4.6
24	4.5	4.5	4.5	5.55	4.25	4.4	4.2	4.45	4.65	4.55
25	4.45	4.45	4.7	4.9	4.3	4.4	4.2	4.35	.....	4.55
26	4.25	4.65	4.75	4.8	4.75	4.45	4.25	4.35	4.55	4.6
27	4.55	4.35	4.8	4.25	4.85	4.45	4.35	4.35	4.35	4.65
28	4.5	4.5	4.9	4.2	4.85	4.45	4.4	4.25	4.45	4.6
29	4.5	4.2	5.15	4.1	4.6	4.45	4.5	4.2	4.65	4.7
30	4.45	4.2	4.75	4.15	4.4	4.35	4.25	4.2	4.5	4.65
31	4.3	.....	4.9	.....	4.2	4.3	.....	4.3	.....	4.65

NOTE.—These gage heights afford only an approximate index of discharge. Owing to the extremely shifting character of the river bed no daily discharges can be computed that will be in any way reliable. Probable ice conditions January to March, 1907, December 11, 1907, to February 29, 1908, and December, 1908.

SOUTH PLATTE RIVER DRAINAGE BASIN.

DESCRIPTION.

The South Platte rises in the mountainous region surrounding the large basin near the center of the State of Colorado, known as South Park, and in the long eastern slopes of the high mountains forming the Continental Divide. The river might properly be said to be formed at South Platte, Colo., by the junction of the North and South forks. The drainage area of the South Fork comprises about 2,150 square miles, and that of the North Fork only about 450 square miles, but there is little difference in the mean annual flow of the two branches. The North Fork is about 50 miles long and the South Fork a little over 100 miles. Geneva Creek, with a drainage area of 50 square miles, is the most important tributary of the North Fork, other tributaries being Deer Park, Elk, and Buffalo creeks. Tarryall Creek and Goose Creek are the principal tributaries of the South Fork.

South Fork, usually considered the main branch of the river, flows in an easterly direction to Lake George, then northward to its junction with the North Fork, and on to the mouth of the Cache la Poudre

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near Greeley. From Greeley its general course is eastward, until it joins the North Platte at the town of North Platte, Nebr.

At the mouth of the South Platte its elevation is 2,800 feet above sea level; 100 miles above the mouth it is 3,600 feet; at Denver, 288 miles above the mouth, it is 5,170 feet; and at South Platte about 6,100 feet. Lake George, about 50 miles up the South Fork, is 8,000 feet above sea level, and Cheesman Reservoir, 23 miles up from South Platte, is 6,850 feet. At the mouth of Geneva Creek, at Grant, Colo., 40 miles up the North Fork from South Platte, the elevation is about 8,500 feet.

The drainage basin, which comprises about 20,000 square miles above Julesburg, Colo., is bisected in an irregular way by the channel of the South Platte. To the north and west lies the mountainous portion, which consists of a long, narrow strip, extending in a north-south direction from a point a short distance above the south boundary of Wyoming to Palmer Lake, Colo. This area furnishes at least 90 per cent of the total run-off of the basin. South and east of the river the basin lies entirely within the plains region.

The mountainous region consists of peaks and jagged masses of granite, with sedimentary rocks cut and gashed by stream channels along the foothills. The stream gradients are steep, and many of the streams consist of series of cascades and rapids. The soil cover as a whole is light, and except during spring freshets or heavy storms the streams are remarkably free from sediment in suspension.

The lower basin, somewhat scarred and broken along the foothills, gradually merges farther east into the undulating prairies so characteristic of the Great Plains east of the Rocky Mountains. The soils of the plains are the product of the disintegration of shales and sandstones, and range from adobe clays to sandy loams. The controlling vegetation is largely native grasses, the only timber being a few bunches of scraggly cottonwoods along the stream channels and small patches of pine, cedar, and piñon along the higher portions.

The forest cover of the mountains, consisting originally of coniferous trees, is rapidly disappearing, but through the occurrence of fires a foothold has been furnished for the deciduous aspen, which is gradually increasing its dominion. Most of the timber land in this drainage is included in the Pike and Medicine Bow national forests; in all there are probably 1,000 square miles of merchantable timber lands.

The tributaries of the South Platte comprise, first, the small streams that rise on the eastern slope of the Rocky Mountains, and, second, the plains streams. The mountain streams furnish a perennial supply of water, the amount of which, however, varies with the snow-
g light during the latter part of the summer and in the fall
er, and large during the spring floods. This water is almost

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entirely diverted for irrigation and does not reach the South Platte except in times of heavy floods. The principal streams of this class are Bear, Clear, Boulder, and St. Vrain creeks and Big Thompson and Cache la Poudre rivers. The plains streams are all intermittent in their nature and furnish water only during storms or in the season of melting snow. The chief streams of this class are Cherry, Lone Tree, Kiowa, Box Elder, Bijou, Beaver, and Pawnee creeks.

In the mountainous regions the flow of the South Platte is perennial, but in the plains area the volume is greatly diminished by the numerous irrigation diversions. At North Platte, Nebr., just above the mouth of the river, the stream channel is dry for the greater part of the year, or consists of several small channels carrying a few second-feet of water.

The river is subject to periodic floods that occur in May and June, the magnitude varying from year to year with seasonal precipitation and temperature. At Julesburg, Colo., the stream flow varies from nothing up to 12,000 second-feet.

The rainfall is 25 inches or more in the highest mountains; 15 to 20 inches between altitudes of 5,500 and 9,000 feet; 10 to 15 inches between 4,000 and 5,000 feet; and in the lower basin, below an elevation of 4,000 feet, from 15 to 20 inches annually.

The winters are very severe, especially above the points where the mountain streams emerge into the more open country. In the mountain sections the snowfall is heavy, and snowstorms are common on the plains areas, but here the snow usually disappears within a few days after each storm. During the winter months the river and its tributaries are frequently frozen over throughout their entire courses. The ice period varies from about two months in the vicinity of Julesburg, Colo., to about five months in the high mountains, where the streams are frozen almost to the bottom. (See Pl. XII.)

The South Platte basin contains the oldest cultivated and irrigated areas in Colorado. At present nearly 1,000,000 acres are under irrigation in Colorado from the South Platte and its tributaries. In fact, the entire normal flow is being used for this purpose, and additional irrigation will necessitate the construction of storage reservoirs or the diversion of water from other drainage areas. The North Grand ditch, which has been in operation for several years, diverts water from the North Fork of Grand River across the divide into Cache la Poudre River. The Laramie-Poudre project, which will soon be begun, contemplates the diversion of the headwaters of Laramie River in the watershed of the North Platte, into the Cache la Poudre, in the watershed of the South Platte; and the Denver Reservoir and Irrigation Company proposes to divert the headwaters of Fraser River, a tributary of the Grand, into the headwaters of South Boulder, a tributary of the South Platte. Other similar

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projects are under consideration.
of the intermittent streams in the
considerable irrigation developme
flow of these streams, but it is
many excellent storage sites are a

About a half million acre-feet of
section of this basin are now being
reservoirs, and a large part of the
irrigation by proper conservation a

Conditions on the upper South Pl
ally favorable for storage (Pl. XI
sites are natural depressions or are
that the reservoirs will have to be s
type is the Standley reservoir of the
Company. This reservoir, which is
a maximum capacity of about 100,0

The largest reservoir which has bee
basin is the Cheesman Lake of the
This reservoir, which was completed i
of 79,000 acre-feet. Among other p
tioned the Antero, Tarryall, Lake Ge
Geneva. Opportunities for storage
Boulder, St. Vrain, Big Thompson, a
excellent reservoir sites have been sur
and no doubt will be developed shortl
portions of these streams will be use
ment, but the stored waters can als
valleys below.

Water-power development is necess
ous parts of the drainage area. Ma
such development are presented on G
Clear Creek, Boulder Creek, Big Tho
Many power sites have been filed upon.
ment in this drainage basin will proba
horsepower, but present develpment
plants with a total capacity of less tha
those plants are on Clear Creek and Bo
Eastern Colorado Power Company, o
above Boulder, Colo., is now under
pleted will have a capacity of probably

Of the years for which Survey record
be the driest and 1907 the wettest. It
flow of the streams in 1909 was consider
that in 1904 was quite high in some pa

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g gaging stations have been maintained in this dr

of South Platte River near Cheesman Lake, Colo., 1899-19
of South Platte River at South Platte, Colo., 1905-1908.
River at South Platte, Colo., 1902-1908.
River near Deansbury (Platte Canyon), Colo., 1887-189

River at Denver, Colo., 1895-1906.
River near Kersey, Colo., 1901-1903, 1905-1908.
River near Orchard, Colo., 1895-1900.
River near Julesburg, Colo., 1902-1906, 1908.
River near Big Spring, Nebr., 1902-3.
ear Cheesman Lake, Colo., 1899.
South Platte River at Cassells, Colo., 1908.
near Grant, Colo., 1908.
r Morrison, Colo., 1888-1891, 1895-1902.
Forkscreek, Colo., 1899-1908.
Golden, Colo., 1897-1898.
near Lyons, Colo., 1888-1892, 1895-1903.
at Orodell, Colo., 1907-8.
near Boulder, Colo., 1888-1892, 1895-1901, 1907-8.
Creek near Boulder, Colo., 1887-1890.
Creek near Marshall, Colo., 1888-1892, 1895-1901.
Creek near Arkins, Colo., 1888-1890, 1895-1903.
ear Arkins, Colo., 1903.
River near Fort Collins, Colo., 1884-1901.
River near Greeley, Colo., 1903.
ek near Hecla, Wyo., 1902-3.

OF SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO

ich was established May 8, 1905, to determ
and the amount of water available on this
e for power and irrigation, is located at
7 S., R. 70 W.
outh forks of the South Platte unite about 5
and the Cheesman reservoir, which interce
d Goose creeks in addition to that of th
0 miles above. No very important trib
an Lake. The drainage area above the
s, of which probably less than 20 per cent
land.
ted above this point except for the irriga
Park, but the flow is regulated by the Ch
a capacity of 79,000 acre-feet. So many
ent have been made on this stream tha
ditional filings can be made except near th

iver at this station is affected by ice for
winter season.

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No change has been made in the gage since it was first established, and the datum remains the same.

Fair results should be obtained at this station, but as the bed is shifting frequent measurements are necessary. The gage heights are apt to show fluctuation at certain times of the year owing to storage or release of water in the Cheesman reservoir.

Discharge measurements of South Fork of South Platte River at South Platte, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12	C. L. Chatfield	34	29	1.20	72
March 11	do	58	49	1.80	138
April 10	do	57	62	1.85	171
Do	do	57	61	1.85	142
May 9	do	61	128	2.88	486
May 28	do	58	85	2.15	251
June 6	do	60	103	2.45	322
June 28	do	63	163	3.45	620
August 8	W. B. Freeman	61	110	2.63	479
August 27	C. L. Chatfield	63	96	2.35	315
October 12	J. B. Stewart	58	51	1.61	149
November 9	do	56	47	1.53	137
December 10	do	48	32	.98	59
1908.					
January 17 [a]	J. B. Stewart	22	32	1.00	27
February 21 [a]	do	35	28	1.08	28
Do. [a b]	do	24	17	1.18	31
March 19	do	62	83	2.10	186
May 11	W. B. Freeman	52.5	47	1.58	129
June 6	Freeman and Stewart	42	36	1.26	74
July 3 [b]	J. B. Stewart	50	60	1.80	153
September 3	do	54	57	1.68	144
October 28	do	48	41	1.20	71
December 17 [a b]	W. B. Freeman	22	16.2	1.32	20.6

[a] Ice conditions. [b] Made by wading.

Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1907 and 1908.

[Miss E. H. Jardine, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1		1.65	1.52	2.02	2.88	3.42	3.58	2.40	1.80	1.55	1.15
2		1.65	1.60	2.12	3.02	3.58	3.52	2.40	1.80	1.55	1.02
3		1.65	1.70	2.20	2.92	3.55	3.45	2.40	1.40	1.70	1.10
4		1.60	1.90	2.28	2.80	3.85	3.35	2.30	1.50	1.60	1.05
5		1.62	2.15	2.20	2.60	3.70	3.10	2.30	1.50	1.55	1.00
6		1.70	2.00	2.28	2.48	3.60	3.95	2.30	1.50	1.55	1.20
7		1.62	2.00	2.40	2.48	3.55	2.75	2.30	1.60	1.60	1.18
8		1.70	1.95	2.68	2.45	3.60	2.65	2.25	1.80	1.55	1.10
9		1.72	1.90	2.85	2.42	3.40	2.50	2.00	1.62	1.55	1.02
10		1.75	1.88	2.80	2.40	3.45	2.50	1.92	1.60	1.50	1.00
11		1.68	1.98	2.80	2.45	3.50	2.50	1.88	1.60	1.42	1.15
12	1.20	1.70	2.22	2.72	2.50	3.48	2.40	1.75	1.60	1.40	.98
13	1.30	1.70	2.15	2.70	2.45	3.25	2.40	1.75	1.60	1.30	1.05
14	1.30	1.65	2.10	2.55	2.70	3.00	2.40	1.75	1.60	1.30	.85
15	1.35	1.50	2.10	2.50	2.80	3.30	2.45	1.75	1.60	1.30	.92
16	1.30	1.48	2.05	2.50	3.25	3.30	2.50	1.78	1.60	1.30	1.10
17	1.35	1.50	2.05	2.50	3.45	3.08	2.45	1.82	1.60	1.30	1.50
18	1.40	1.70	2.00	2.50	3.50	2.65	2.38	1.82	1.60	1.25	1.72
19	1.40	1.80	2.00	2.40	3.70	2.52	2.35	2.00	1.50	1.20	1.78
20	1.40	2.08	2.00	2.40	3.95	2.35	2.45	2.10	1.50	1.30	1.82

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Daily gage height, in feet, of South Fork of South Platte River at South Platte, Colo., for 1907 and 1908—Continued.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
21	1.45	2.10	1.85	2.40	4.20	2.28	2.55	2.10	1.50	1.30	1.82
22	1.45	2.30	1.85	2.45	4.10	2.28	2.60	2.10	1.50	1.30	1.82
23	1.50	2.25	1.95	2.50	3.88	2.30	2.52	2.08	1.50	1.30	1.52
24	1.60	2.20	1.98	2.45	3.60	2.70	2.40	2.00	1.52	1.30	1.42
25	1.60	2.00	2.15	2.45	3.50	2.85	2.40	2.00	1.58	1.30	1.42
26	1.62	2.00	2.28	2.40	3.50	3.10	2.38	2.05	1.50	1.15	1.42
27	1.65	1.80	2.25	2.35	3.58	3.78	2.38	2.05	1.60	1.18	1.15
28	1.65	1.80	2.25	2.20	3.55	4.55	2.50	2.00	1.65	1.12	1.10
29	.....	1.78	2.20	2.22	3.48	4.90	2.42	1.92	1.70	1.05	1.98
30	.....	1.60	2.12	2.50	3.42	4.42	2.38	1.80	1.80	1.15	1.10
31	.....	1.60	.....	2.75	.....	3.85	2.42	.....	1.65	.....	1.08
1908.											
1	.....	.....	1.5	1.5	1.2	1.75	2.0	2.0	1.6	1.2	1.4
2	.....	.....	1.5	1.5	1.9	1.8	2.4	1.8	1.55	1.2	1.4
3	.....	.....	1.5	1.5	1.5	1.8	2.35	1.7	1.55	1.2	1.4
4	.....	.....	1.5	1.55	1.35	1.65	2.35	1.65	1.5	.8	1.3
5	.....	.....	1.5	1.5	1.3	1.65	2.5	1.5	1.5	.7	1.3
6	.....	.....	1.55	1.4	1.25	1.65	2.6	1.5	1.5	.7	1.2
7	.....	.....	1.6	1.5	1.3	1.65	2.35	1.5	1.4	.7	1.0
8	.....	1.0	1.6	1.6	1.3	1.65	2.3	1.5	1.35	.7	1.15
9	.....	.9	1.6	1.7	1.3	1.6	2.3	1.45	1.35	.7	1.2
10	.....	.9	1.6	1.65	1.3	1.6	2.3	1.4	1.35	.7	1.45
11	.....	.9	1.6	1.6	1.9	1.85	2.3	1.35	1.3	.7	1.45
12	.....	.9	1.6	1.5	1.9	2.25	2.0	1.4	1.25	.7	1.55
13	.....	.95	1.6	1.4	1.9	1.6	2.0	1.5	1.25	.6	1.2
14	.....	.95	1.6	1.35	1.9	1.75	2.0	1.5	1.3	.95	1.3
15	.....	.95	1.65	1.3	1.9	1.9	2.0	2.0	1.25	.9	1.3
16	.....	.95	1.7	1.3	1.9	1.9	2.1	2.0	1.25	1.1	1.45
17	.....	1.2	1.7	1.2	1.9	1.9	2.25	2.0	1.25	1.2	1.3
18	.....	1.9	1.75	1.25	1.9	1.9	2.3	2.0	1.3	1.0	1.4
19	.....	2.1	1.8	1.3	1.8	2.1	2.3	2.0	1.3	.9	1.4
20	.....	2.1	1.8	1.35	1.8	2.05	2.3	1.9	1.35	.9	1.5
21	.....	2.05	1.7	1.4	1.5	2.0	2.5	1.8	1.4	.8	2.0
22	.....	2.05	1.7	1.45	1.5	2.0	2.7	1.8	1.4	.7	2.0
23	.....	1.9	1.7	1.3	1.45	2.0	2.6	1.8	1.3	.7	2.0
24	.....	1.8	1.6	1.3	1.4	1.95	2.55	1.8	1.25	.65	1.8
25	.....	1.7	1.55	1.3	1.4	2.0	2.45	1.6	1.3	.7	1.4
26	.....	1.7	1.5	1.3	1.4	2.0	2.4	1.7	1.3	.75	1.8
27	.....	1.7	1.5	1.3	1.4	2.0	2.35	1.7	1.2	.8	1.8
28	.....	1.7	1.5	1.25	1.55	1.9	1.7	1.7	1.2	1.05	1.8
29	.....	1.6	1.5	1.2	1.75	1.8	1.7	1.7	1.45	1.0	1.8
30	.....	1.6	1.5	1.3	1.75	1.8	2.05	1.6	1.35	1.15	1.75
31	.....	1.5	.....	1.3	.....	1.9	2.0	.....	1.2	.....	1.9

NOTE.—Ice conditions January 1 to about February 12, 1907, December 15, 1907, to March 7, 1908, and after November 13, 1908. Water standing in pools November 4–13, 1908.

Rating tables for South Fork of South Platte River at South Platte, Colo.

FEBRUARY 12 TO JULY 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	55	1.90	165	2.80	455	3.70	980
1.10	63	2.00	190	2.90	505	3.80	1,045
1.20	72	2.10	215	3.00	560	3.90	1,110
1.30	82	2.20	240	3.10	615	4.00	1,175
1.40	92	2.30	270	3.20	670	4.20	1,310
1.50	102	2.40	300	3.30	730	4.40	1 450
1.60	113	2.50	335	3.40	790	4.60	1,590
1.70	127	2.60	370	3.50	850	4.80	1,730
1.80	145	2.70	410	3.60	915	5.00	1,870

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the above period and on the form of the 1906 curve. It is well defined above gage height 1.2 feet. Above gage height 1.8 feet it is the same as the 1906 table.

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Rating tables for South Fork of South Platte River at South Platte, Colo.—Continued.

AUGUST 1 TO DECEMBER 31, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	50	1.70	170	2.50	410	3.30	770
1.00	60	1.80	190	2.60	450	3.40	820
1.10	70	1.90	215	2.70	495	3.50	870
1.20	85	2.00	240	2.80	540	3.60	925
1.30	100	2.10	265	2.90	585	3.70	980
1.40	115	2.20	295	3.00	630		
1.50	130	2.30	330	3.10	675		
1.60	150	2.40	370	3.20	720		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period and the form of previous curves. It is well defined.

MARCH 8 TO MARCH 30, 1908.

0.90	35	1.30	61	1.70	112	2.10	186
1.00	40	1.40	72	1.80	128		
1.10	45	1.50	84	1.90	147		
1.20	52	1.60	98	2.00	166		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during the above period and the form of preceding curves. It is not well defined.

MARCH 31 TO APRIL 25, 1908.

[Indirect method for shifting channels used.]

APRIL 26 TO NOVEMBER 3, 1908.

1.20	71	1.60	126	2.00	200	2.40	303
1.30	80	1.70	144	2.10	222	2.50	335
1.40	94	1.80	162	2.20	247	2.60	370
1.50	110	1.90	181	2.30	274	2.70	410

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period and the form of preceding curves, and is well defined between gage heights 1.2 feet and 1.9 feet

Daily discharge, in second-feet, of South Fork of South Platte River at South Platte, Colo., for 1908.

Day.	Mar.	Apr.	Day.	Mar.	Apr.	Day.	Mar.	Apr.
1		86	11		110	21		135
2		89	12		112	22		130
3		93	13		115	23		125
4		96	14		120	24		120
5		98	15		125	25		115
6		100	16		133	26		
7		102	17		140	27		
8		104	18		145	28		
9		106	19		150	29		
10		108	20		155	30		
						31	84	

NOTE.—These discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of South Fork of South Platte River at South Platte, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy
	Maximum.	Minimum.	Mean.		
1907.					
February 12-28	120	72	96.8	3,260	C.
March	270	100	146	8,980	A.
April	264	104	194	11,500	A.
May	480	195	325	20,000	A.
June	1,310	300	667	39,700	A.
July	1,800	264	782	48,100	A.
August	914	350	472	29,000	B.
September	370	180	255	15,200	A.
October	190	115	149	9,160	A.
November	170	65	111	6,600	A.
December	85	35	53.3	3,280	C.
The period				195,000	
1908.					
January			30	1,840	D.
February			30	1,730	D.
March	186	35	80.7	4,960	C.
April	155	86	115	6,840	B.
May	144	71	95.5	5,870	B.
June	181	71	127	7,560	A.
July	260	126	173	10,600	A.
August	410	144	269	16,500	A.
September	200	87	144	8,570	A.
October	126	71	88.4	5,440	A.
November	71	0	29.9	1,780	D.
December			23.4	1,440	D.
The year	410	0	100	73,100	

NOTE.—Discharge estimated December 16, 1907, to March 7, 1908, and November 14 to December 31, 1908. No flow November 4-13, 1908.

SOUTH PLATTE RIVER AT SOUTH PLATTE, COLO.

This station, which was established March 28, 1902, furnishes valuable data for use in connection with storage, irrigation, and water-power development. It is located on the Colorado and Southern Railroad in T. 7 S., R. 7 W., about 9 miles above the mouth of the canyon and just below the junction of the North and South forks. Records at Platte Canyon and at Deansbury, a few miles below, extend back to 1887, with the exception of the years 1893 and 1894, and records at Platte Canyon are still being taken by the Denver Union Water Company. The earlier records, 1887–1892, were taken by the state engineer, and the records from 1895 to 1898 were taken under the direction of the Denver Power and Irrigation Company.

The station is especially important because of its location above the head-gates of all irrigation systems and also above the intake of the Denver Union Water Company. The location of the Cheesman storage reservoir on the South Fork, 20 miles above this station, and the proposed installation of several power plants on both forks of the river above add to the importance of the station.

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A great many filings for power development have been made on the tributaries of the river above this point, but doubtless opportunities for additional filings still exist.

The flow of the South Fork of the South Platte is regulated by storage in Cheesman reservoir. The flow of the North Fork is natural, except for slight variations due to the many ice and fish ponds for 30 miles above its mouth.

The river and its tributaries are usually frozen over from two to four months during the winter time.

On May 7, 1905, the gage was moved from the county bridge to a point 150 feet downstream, which no doubt caused some change in the relation of gage readings.

The stream bed is more or less shifting, and frequent discharge measurements are necessary to obtain the best results. The gage readings taken twice each day are apt to show considerable fluctuation owing to the regulation of the flow from the Cheesman reservoir.

Discharge measurements of South Platte River at South Platte, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12	C. L. Chatfield	73	65	1.70	129
March 11	do	75	90	2.00	211
April 10	do	75	100	2.18	258
Do	do	75	103	2.20	263
May 9	do	78	202	3.15	665
May 28	do	79	187	2.85	618
June 6	do	78	242	3.45	952
June 28	do	79	285	4.12	1,200
August 8	W. B. Freeman	76	196	3.11	751
August 27	C. L. Chatfield	78	165	2.72	510
October 12	J. B. Stewart	77	102	2.10	223
November 9	do	75	83	2.05	196
December 10 [a]	do	74	62	1.70	84
1908.					
January 17 [a]	J. B. Stewart	39	44	1.74	80
February 21 [a]	do	36.5	45	1.45	93
March 19	do	77	111	2.30	232
May 11	W. B. Freeman	74	83	2.10	190
June 6	J. B. Stewart	76	90	2.08	207
July 3	do	76	102	2.15	236
September 3	do	75	97	2.20	232
October 28	do	75	76	1.80	145
December 17 [a]	W. B. Freeman	23	38	1.55	59

[a] Ice conditions.

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Daily gage height, in feet, of South Platte River at South Platte, Colo., for 1907 and

[E. H. Jardine, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1907.										
1	.....	1.95	2.02	2.30	3.40	4.05	4.00	2.80	2.25	2.02
2	.....	1.98	2.00	2.45	3.50	4.18	4.05	2.80	2.28	2.00
3	.....	1.95	2.00	2.42	3.45	4.22	3.88	2.80	2.00	2.10
4	.....	1.90	2.20	2.55	3.32	4.20	3.75	2.60	2.00	2.05
5	.....	1.92	2.35	2.50	3.30	4.20	3.70	2.60	2.10	2.00
6	.....	1.98	2.30	2.50	3.50	4.02	3.40	2.60	2.10	2.00
7	.....	1.92	2.20	2.70	3.40	4.05	3.22	2.65	2.10	2.00
8	.....	1.92	2.20	2.90	3.40	4.10	3.12	2.55	2.30	2.08
9	.....	1.95	2.20	3.15	3.35	3.85	3.10	2.40	2.20	2.05
10	.....	1.98	2.18	3.12	3.25	4.00	3.00	2.40	2.15	2.00
11	.....	1.98	2.30	3.10	3.25	4.00	3.00	2.35	2.20	1.90
12	1.70	1.92	2.42	3.15	3.55	3.90	2.90	2.30	2.10	1.95
13	1.65	1.90	2.45	3.12	3.60	3.70	2.90	2.25	2.10	1.80
14	1.65	1.90	2.40	2.95	3.70	3.62	2.90	2.25	2.10	1.70
15	1.65	1.82	2.40	2.90	3.78	3.70	3.00	2.25	2.10	1.70
16	1.65	1.88	2.38	2.90	3.95	3.70	2.90	2.22	2.10	1.70
17	1.70	1.95	2.32	2.90	3.90	3.40	2.85	2.25	2.10	1.70
18	1.75	2.00	2.30	2.90	3.95	3.65	2.80	2.22	2.00	1.65
19	1.75	2.00	2.30	3.20	4.22	2.90	2.70	2.35	2.00	1.62
20	1.75	2.18	2.20	3.12	4.32	2.90	2.80	2.40	2.00	1.70
21	1.80	2.30	2.10	3.40	4.52	2.85	2.85	2.40	2.00	1.70
22	1.82	2.38	2.22	3.40	4.40	2.85	2.90	2.40	2.00	1.70
23	1.85	2.30	2.32	3.30	4.32	2.90	2.82	2.40	2.00	1.70
24	2.00	2.38	2.38	3.20	4.30	3.10	2.75	2.35	2.05	1.70
25	1.95	2.30	2.40	3.10	4.05	3.20	2.68	2.32	2.10	1.70
26	1.95	2.50	2.48	3.08	4.00	3.65	2.70	2.40	2.02	1.78
27	1.95	2.20	2.45	2.95	4.15	3.80	2.80	2.40	2.10	1.72
28	1.95	2.10	2.40	2.90	4.08	4.78	2.88	2.30	2.15	1.70
29	.....	2.05	2.40	2.90	4.05	5.10	2.80	2.25	2.15	1.78
30	.....	2.00	2.40	3.08	4.00	4.48	2.80	2.30	2.15	1.72
31	.....	2.00	.....	3.20	.....	4.12	2.80	.....	2.00	.....
1908.										
1	.....	.....	2.0	1.95	2.0	2.2	2.4	2.35	2.0	1.8
2	.....	.....	2.0	1.95	2.35	2.2	2.65	2.35	2.0	1.8
3	.....	.....	1.95	1.95	2.3	2.2	2.6	2.25	2.0	1.8
4	.....	.....	2.0	2.1	2.1	2.1	2.5	2.2	2.05	1.6
5	.....	.....	2.0	2.05	2.1	2.1	2.6	2.1	2.0	1.55
6	.....	.....	2.0	1.95	2.1	2.1	3.2	2.0	2.0	1.55
7	.....	.....	2.0	2.1	2.0	2.1	2.6	1.95	2.0	1.55
8	.....	1.5	2.0	2.2	2.0	2.05	2.5	1.9	2.0	1.5
9	.....	1.4	2.0	2.3	2.0	2.0	2.5	2.1	2.0	1.5
10	.....	1.5	2.05	2.2	2.0	2.05	2.5	2.0	2.0	1.5
11	.....	1.4	2.05	2.1	2.5	2.25	2.5	2.0	1.9	1.5
12	.....	1.45	2.05	2.0	2.4	2.6	2.4	2.1	2.0	1.5
13	.....	1.5	2.1	1.95	2.4	2.4	2.3	2.2	1.8	1.45
14	.....	1.5	2.1	1.95	2.4	2.4	2.3	2.2	1.85	1.5
15	.....	1.5	2.15	1.9	2.5	2.35	2.3	2.5	1.9	1.8
16	.....	1.5	2.15	1.9	2.4	2.35	2.4	2.4	1.9	1.8
17	.....	1.7	2.2	1.9	2.4	2.35	2.5	2.3	1.9	2.0
18	.....	2.2	2.25	1.95	2.4	2.35	2.6	2.3	1.9	2.1
19	.....	2.3	2.3	2.0	2.4	2.45	2.65	2.3	1.9	1.95
20	.....	2.3	2.2	2.15	2.3	2.3	2.7	2.3	1.9	1.8
21	.....	2.25	2.15	2.2	2.2	2.3	2.85	2.2	1.9	1.8
22	.....	2.2	2.15	2.2	2.1	2.3	2.9	2.2	2.0	1.7
23	.....	2.1	2.1	2.1	2.1	2.3	2.8	2.2	2.0	1.7
24	.....	2.1	2.1	2.2	2.1	2.35	2.8	2.2	2.0	1.65
25	.....	2.1	2.05	2.2	2.05	2.35	2.75	2.1	1.9	1.7
26	.....	2.1	2.0	2.1	2.05	2.3	2.75	2.2	1.8	1.7
27	.....	2.1	1.95	2.1	2.05	2.3	2.7	2.2	1.8	1.7
28	.....	2.1	1.95	2.0	2.2	2.2	2.35	2.2	1.9	1.65
29	.....	2.0	1.95	2.0	2.2	2.2	2.3	2.2	2.0	1.7
30	.....	2.0	1.95	2.0	2.2	2.2	2.4	2.1	1.9	1.7
31	.....	2.0	.....	2.0	.....	2.45	2.4	.....	1.8	.....

NOTE.—Ice conditions January 1 to February 12, 1907, November 25, 1907, to March 7, 1908, a November 14, 1908.

31260—IRR 246—10——17

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Rating tables for South Platte River at South Platte, Colo.

FOR 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	105	2.50	385	3.40	920	4.30	1,550
1.70	125	2.60	435	3.50	990	4.40	1,625
1.80	145	2.70	490	3.60	1,060	4.50	1,700
1.90	170	2.80	545	3.70	1,130	4.60	1,775
2.00	200	2.90	600	3.80	1,200	4.70	1,850
2.10	230	3.00	660	3.90	1,270	4.80	1,930
2.20	265	3.10	720	4.00	1,340	4.90	2,010
2.30	300	3.20	785	4.10	1,410	5.00	2,090
2.40	340	3.30	850	4.20	1,480	5.20	2,250

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on thirteen discharge measurements made during 1907 and on earlier high-water measurements. It is well defined between gage heights 1.7 feet and 3.5 feet. Above gage height 3.9 feet it is the same as the 1905 table.

MARCH 8 TO NOVEMBER 14, 1908.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of South Platte River at South Platte, Colo., for 1908.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	155	152	180	255	315	285	188	145
2	.....	155	152	295	255	428	285	188	145
3	.....	145	152	280	255	405	250	188	145
4	.....	155	190	210	220	360	232	215	105
5	.....	155	175	210	220	405	202	188	94
6	.....	155	152	210	220	740	175	188	94
7	.....	155	190	182	220	405	162	188	94
8	75	155	220	182	208	360	150	188	88
9	63	155	250	182	194	360	202	188	88
10	75	168	220	182	208	360	175	188	88
11	55	168	190	360	275	360	175	162	88
12	62	168	165	320	420	315	202	188	88
13	68	180	152	320	335	280	240	140	80
14	68	180	152	320	335	280	240	150	88
15	68	195	140	360	312	280	350	162	.....
16	68	195	140	320	312	315	312	162	.....
17	90	210	140	320	312	360	275	162	.....
18	200	225	160	320	312	405	275	162	.....
19	230	240	172	320	335	410	275	168	.....
20	230	210	215	280	280	435	275	168	.....
21	215	195	230	255	280	510	240	168	.....
22	200	195	230	220	280	540	240	194	.....
23	172	180	200	220	280	485	240	194	.....
24	172	180	230	220	295	485	240	194	.....
25	172	168	230	208	295	460	210	168	.....
26	172	155	200	208	280	460	240	140	.....
27	172	145	200	208	280	435	240	140	.....
28	172	152	172	255	245	285	240	168	.....
29	150	152	172	255	245	265	240	200	.....
30	150	152	172	255	245	305	210	172	.....
31	150	.....	172	.....	335	305	.....	145	.....

NOTE.—The discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of South Platte River at South Platte, Colo., for 1907 and 1908.

[Drainage area, 2,610 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 12-28	200	115	148	0.057	0.04	4,990	B.
March	385	150	218	.084	.10	13,400	A.
April	376	200	299	.115	.13	17,800	A.
May	920	300	637	.244	.28	39,200	B.
June	1,720	818	1,200	.460	.51	71,400	B.
July	2,170	572	1,190	.456	.53	73,200	B.
August	1,380	479	708	.271	.31	43,500	A.
September	545	272	355	.136	.15	21,100	A.
October	300	200	231	.089	.10	14,200	A.
November	230	91	153	.059	.07	9,100	B.
December	84	80	82.3	.032	.04	5,060	D.
The period						313,000	
1908.							
January			80	.031	.04	4,920	D.
February			90	.034	.04	5,180	D.
March	230	55	123	.047	.05	7,560	C.
April	240	145	173	.066	.07	10,300	B.
May	250	140	183	.070	.08	11,300	B.
June	360	180	255	.098	.11	15,200	B.
July	420	194	276	.106	.12	17,000	B.
August	740	265	391	.150	.17	24,000	B.
September	350	150	236	.090	.10	14,000	B.
October	215	140	175	.067	.08	10,800	B.
November	145	75	91.2	.035	.04	5,430	C.
December	105	60	71.3	.027	.03	4,380	D.
The year			179	.068	.93	130,000	

NOTE.—Discharge estimated November 25, 1907, to March 7, 1908, and November 15 to December 31, 1908, the probable frozen periods.

SOUTH PLATTE RIVER NEAR KERSEY, COLO.

This station, which was established April 27, 1901, is located at a pile bridge about 1½ miles north of Kersey on the Union Pacific Railroad about 6 miles east of Greeley in T. 5 N., R. 64 W. The station was discontinued during the fall of 1903, but was reestablished March 5, 1905.

The station is below all the important tributaries of the South Platte that derive their supply from the mountain region, and the records are therefore particularly important as showing the amount of water available for storage reservoirs in northeastern Colorado.

Cache la Poudre River, a very important tributary of the South Platte, enters 2 or 3 miles above the station. Crow Creek and Boxelder Creek, two intermittent streams, come in from the north and south sides, 4 or 5 miles below. The drainage area at Kersey is 9,500 square miles.

Above Kersey are numerous irrigation and canal systems serving one of the most extensively irrigated areas in Colorado. Nearly 790,000 acres were irrigated above this station in 1907, about 380,000 acre-feet of water were stored, and about half of it used during the

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season. In 1908 about 300,000 acre-feet were stored, all of which was used for irrigation.

No important water-power plants are operated on the South Platte or its tributaries above the station, but one or two are now under construction and several are contemplated. In order to secure additional water rights for irrigation it will be necessary to construct storage works on some of the tributaries, as filings greatly in excess of the natural flow of the stream have been on record for a number of years.

The river is generally frozen over from the middle of December to the first of March.

In the fall of 1906 a chain gage was established on each of the two channels into which the river is divided at ordinary stages. Formerly one rod gage was used, but it was found that the elevation of the water surface in the two channels differed considerably. Owing to the shifting character of the stream bed, a slight change in the datum of the gage is not apt to seriously affect the value of the results, as marked changes occur in the rating curve from one season to the next and often during a single season.

Measurements should be taken at this station on an average of at least once every three weeks, except when the river is at a constant stage. Accurate results are rather difficult to obtain on account of the piles of the bridge and the fact that the bridge is not at right angles to the direction of the current. Whenever possible measurements should be taken by wading. At high stages the river flows in three channels and during extreme floods overflows into one or two channels on the left bank.

Discharge measurements of South Platte River near Kersey, Colo. (gage No. 1), in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	R. I. Meeker	110	118	2.97	244
March 29	C. L. Chatfield	103	98	2.50	185
April 8	do	105	103	2.60	195
May 31	W. B. Freeman	114	218	3.82	619
June 19	do	116	223	3.76	545
July 2	C. L. Chatfield	168	496	5.88	1,450
July 28	W. B. Freeman	159	453	5.56	1,690
August 20	do	63	55	2.33	93
October 12	do	96	129	3.12	287
October 22	J. B. Stewart	92	119	2.95	214
December 18[a]	do	60	99	2.90	246
1908.					
March 13	J. B. Stewart	72	88	2.69	163
May 13	W. B. Freeman	32	22.7	1.85	35.4
June 11[b]	do	26	25.2	1.79	44.0
July 22[b]	J. B. Stewart	31.5	37.1	1.98	55.0
August 29[b]	do	30.5	31	1.85	54.0
November 3	do	41	60	2.60	133

[a] Slush ice and ice around piles and on the edges. [b] Made by wading.

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Daily gage height, in feet, of South Platte River near Kersey, Colo. (gage No. 1), for 1907 and 1908.

[C. A. Maisner and Mrs. J. C. Maisner, observers.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	2.90	.....	3.12	4.50	5.58	5.22	2.52	3.12	3.00	3.05
2	.....	2.90	.....	3.15	4.45	5.75	4.92	2.45	3.28	3.00	3.05
3	.....	2.85	.....	3.18	4.50	5.58	4.78	2.45	3.30	3.02	3.05
4	.....	2.85	.....	3.20	4.80	5.32	4.62	2.40	3.28	3.05	3.05
5	.....	2.80	.....	3.30	4.45	5.05	4.55	2.35	3.25	3.05	3.05
6	.....	2.80	.....	3.42	4.30	5.12	4.30	2.32	3.20	3.05	3.05
7	.....	2.75	.....	3.68	4.55	4.78	4.00	2.42	3.15	3.05	3.05
8	.....	2.75	2.60	3.85	4.62	4.40	3.60	2.40	3.15	3.08	3.05
9	.....	2.75	2.45	3.88	4.42	4.20	3.30	2.48	3.15	3.10	3.05
10	.....	2.70	2.35	3.88	4.50	3.75	3.15	2.65	3.15	3.15	3.05
11	.....	2.70	2.22	3.85	3.85	3.78	2.92	2.55	3.15	3.15	3.05
12	.....	2.70	2.30	3.80	3.15	3.65	2.85	2.52	3.15	3.15	3.00
13	3.00	2.70	2.00	3.92	3.20	3.35	2.65	2.50	3.08	3.20	3.05
14	3.00	2.65	1.92	4.28	3.20	3.35	2.50	2.45	3.05	3.20	3.10
15	3.00	2.65	1.78	4.58	3.70	3.20	2.48	2.50	3.05	3.15	3.02
16	3.00	2.60	1.70	4.55	4.10	3.12	2.40	2.52	2.95	3.15	3.00
17	3.00	2.60	1.70	4.35	4.40	2.80	2.38	2.55	2.95	3.15	3.00
18	3.00	2.60	1.65	4.18	3.85	2.58	2.35	2.58	2.90	3.15	2.92
19	2.95	2.60	1.60	3.98	3.65	2.45	2.38	2.60	2.90	3.15	2.90
20	2.90	2.55	2.00	4.02	3.85	2.38	2.43	2.60	2.92	3.15	2.95
21	2.85	2.55	2.62	4.25	3.70	2.22	2.40	2.65	2.95	3.15	2.90
22	2.85	2.55	2.92	4.25	3.70	2.22	2.30	2.65	2.95	3.15	2.90
23	2.85	2.55	2.50	4.32	3.75	2.28	2.30	2.68	2.92	3.10	2.98
24	2.85	2.55	3.00	4.15	4.15	2.20	2.30	2.70	2.92	3.05	2.98
25	2.90	2.55	2.90	4.38	4.20	2.20	2.28	2.75	2.98	3.05	3.05
26	2.90	2.55	2.82	4.38	4.82	2.25	2.30	2.75	3.00	3.05	3.08
27	2.90	2.55	2.78	3.98	5.50	4.60	2.30	2.80	3.00	3.05	3.05
28	2.90	2.55	2.75	3.50	5.60	5.48	2.30	2.80	3.05	3.05	3.10
29	.....	2.5	3.20	3.22	5.58	5.52	2.30	2.88	3.05	3.05	3.10
30	.....	2.5	3.12	3.18	5.38	5.62	2.48	3.00	3.05	3.05	3.00
31	.....	2.5	.....	3.60	.....	5.52	2.75	.....	3.05	.....	2.90
1908.											
1	.....	.....	2.15	1.7	2.0	1.8	2.3	1.8	2.15	2.7	.....
2	.....	.....	2.15	1.7	1.9	1.8	1.95	1.8	2.2	2.6	.....
3	.....	.....	2.15	1.7	1.9	1.8	1.9	1.85	2.2	2.6	.....
4	.....	.....	2.1	.....	1.9	1.8	1.8	1.85	2.2	2.6	.....
5	.....	.....	2.1	2.0	1.85	1.8	1.8	1.85	2.2	2.6	.....
6	.....	.....	.....	2.2	1.85	1.8	1.8	1.85	2.3	2.6	.....
7	.....	.....	.....	2.2	1.85	1.8	1.85	1.85	2.3	2.55	.....
8	.....	.....	.....	2.4	1.8	1.8	2.0	1.9	2.3	2.5	.....
9	.....	.....	2.1	2.2	1.8	1.8	1.95	1.9	2.3	2.5	.....
10	.....	2.7	2.5	1.9	1.8	1.8	2.0	1.9	2.3	2.5	.....
11	.....	2.7	1.95	1.85	1.8	1.8	2.0	1.9	2.3	2.5	.....
12	.....	2.7	1.95	1.85	1.8	1.8	1.95	1.9	2.3	2.5	.....
13	.....	2.7	1.95	1.85	1.8	1.8	2.0	1.95	2.3	2.6	.....
14	.....	2.7	1.95	1.8	1.8	1.85	2.0	1.95	2.3	2.7	.....
15	.....	2.6	1.95	1.8	2.0	1.85	2.0	1.95	2.4	2.7	.....
16	.....	2.6	1.9	1.8	2.2	1.85	2.0	2.0	2.4	2.7	.....
17	.....	2.6	1.9	1.8	2.2	1.8	2.0	2.0	2.55	2.8	.....
18	.....	2.6	1.85	1.8	1.95	1.8	2.5	2.0	2.8	2.8	.....
19	.....	2.6	1.85	1.8	1.9	1.95	2.1	1.95	2.95	2.8	.....
20	.....	2.55	1.8	1.75	1.95	2.25	2.15	2.0	3.0	2.8	.....
21	.....	2.4	1.8	1.75	2.0	2.0	2.2	2.0	3.5	2.8	.....
22	.....	2.3	1.8	1.75	2.0	2.0	2.5	1.95	3.0	2.8	.....
23	.....	2.3	1.8	1.75	1.9	1.9	2.65	1.9	2.9	2.75	.....
24	.....	2.25	1.7	2.3	1.9	1.8	2.6	1.9	2.9	2.7	.....
25	.....	2.25	1.75	2.9	1.9	1.8	2.2	1.95	2.8	2.7	.....
26	.....	2.25	1.7	2.2	1.85	1.8	2.05	1.95	2.8	2.7	.....
27	.....	2.25	1.7	2.3	1.8	1.8	2.0	2.0	2.8	2.6	.....
28	.....	2.2	1.7	2.3	1.9	1.8	1.9	2.2	2.75	2.75	.....
29	.....	2.2	1.7	2.3	1.9	1.8	1.85	2.2	2.75	2.8	.....
30	.....	2.2	1.7	2.2	1.85	1.8	1.8	2.2	2.75	2.9	.....
31	.....	2.2	.....	2.0	.....	3.3	1.8	.....	2.75	.....	.....

NOTE.—Probable ice conditions January 1 to February 12, 1907, January 1 to March 9, and December, 1908.

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Rating tables for South Platte River near Kersey, Colo. (gage No. 1).

FEBRUARY 1 TO MAY 6, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	98	2.10	143	2.60	191	3.10	275
1.60	105	2.20	151	2.70	203	3.20	310
1.70	112	2.30	160	2.80	217	3.30	350
1.80	119	2.40	170	2.90	233	3.40	390
1.90	127	2.50	180	3.00	250	3.50	435
2.00	135						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during the above period and is well defined above gage height 2.5 feet.

MAY 7 TO DECEMBER 31, 1907.

2.20	70	3.20	315	4.20	795	5.20	1,420
2.30	90	3.30	355	4.30	850	5.30	1,490
2.40	110	3.40	395	4.40	905	5.40	1,565
2.50	130	3.50	440	4.50	965	5.50	1,640
2.60	150	3.60	485	4.60	1,025	5.60	1,720
2.70	170	3.70	530	4.70	1,085	5.70	1,800
2.80	195	3.80	580	4.80	1,150	5.80	1,880
2.90	220	3.90	630	4.90	1,215	5.90	1,960
3.00	250	4.00	685	5.00	1,280	6.00	2,040
3.10	280	4.10	740	5.10	1,350		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during the above period and is fairly well defined.

MARCH 10 TO NOVEMBER 30, 1908.

1.70	37	2.20	75	2.70	165	3.20	315
1.80	42	2.30	86	2.80	191	3.30	350
1.90	49	2.40	100	2.90	220	3.40	385
2.00	56	2.50	118	3.00	250	3.50	425
2.10	65	2.60	140	3.10	280		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908 and is fairly well defined between gage heights 1.8 feet and 2.8 feet.

Discharge measurements of South Platte River near Kersey, Colo. (gage No. 2), in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5	R. I. Meeker	135	232	3.01	446
March 29	C. L. Clatfield	148	166	2.50	330
April 8	do	136	191	2.70	378
May 31	W. B. Freeman	143	339	3.86	1,150
June 19	do	143	273	3.67	797
July 2	C. L. Chatfield	287	848	5.55	2,500
July 28	W. B. Freeman	245	795	5.58	2,730
August 20	do	54	53	1.83	59
October 12	do	134	236	3.22	508
October 22	J. B. Stewart	136	204	3.01	425
December 18[a]	do	127	179	2.90	391
1908.					
March 13	J. B. Stewart	129	153	2.80	252
May 13	W. B. Freeman	69	50	1.70	60
June 11[b]	do	42	35	1.41	37
July 22[b]	J. B. Stewart	58	48	1.94	80
August 29[b]	do	45.5	47	1.90	90
[illegible]ber 3	do	132	180	2.75	280

[a] Slush ice and ice around piles and on the edges.

[b] Made by wading.

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Daily gage height, in feet, of South Platte River near Kersey, Colo. (gage No. 2), for 1907 and 1908.

[C. A. Maisner and Mrs. J. C. Maisner, observers.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.											
1	.....	2.92	.....	3.25	4.50	5.20	5.15	2.15	3.18	3.05	3.10
2	.....	2.92	.....	3.32	4.40	5.38	4.85	2.02	3.28	3.10	3.10
3	.....	2.88	.....	3.28	4.40	5.22	4.68	2.00	3.30	3.10	3.10
4	.....	2.88	.....	3.25	4.75	4.90	4.52	1.95	3.30	3.15	3.10
5	.....	2.82	.....	3.38	4.42	4.65	4.48	1.88	3.35	3.15	3.10
6	.....	2.82	.....	3.48	4.28	4.75	4.15	1.82	3.28	3.15	3.10
7	.....	2.75	.....	3.72	4.55	4.38	3.58	2.00	3.22	3.15	3.10
8	.....	2.75	2.65	3.85	4.52	4.02	3.40	1.98	3.20	3.15	3.10
9	.....	2.75	2.50	3.85	4.40	3.58	3.08	2.30	3.30	3.15	3.10
10	.....	2.70	2.40	3.85	4.42	3.30	2.85	2.45	3.28	3.15	3.10
11	.....	2.70	2.25	3.88	3.90	3.35	2.72	2.10	3.25	3.20	3.10
12	.....	2.70	2.30	3.85	3.25	3.40	2.40	2.15	3.30	3.20	3.08
13	3.10	2.70	2.25	4.25	3.08	2.90	(a)	2.50	3.20	3.20	3.10
14	3.10	2.68	1.95	4.32	3.32	2.55	(a)	2.50	3.20	3.20	3.15
15	3.05	2.68	1.82	4.52	3.85	2.70	(a)	2.10	3.15	3.18	3.10
16	3.00	2.65	1.75	4.45	4.18	2.60	(a)	2.12	3.08	3.15	3.00
17	3.00	2.65	1.75	4.32	4.28	2.38	(a)	2.12	3.06	3.20	3.00
18	3.00	2.65	1.72	4.18	4.10	2.28	(a)	2.32	3.00	3.20	2.92
19	2.98	2.65	1.70	4.30	3.65	2.12	(a)	2.42	3.00	3.20	2.90
20	2.95	2.62	2.20	4.15	3.85	2.30	(a)	2.45	3.00	3.20	2.95
21	2.92	2.62	2.80	4.15	3.72	(a)	1.80	2.50	3.00	3.20	2.95
22	2.95	2.62	3.12	4.12	3.70	(a)	1.80	2.60	3.00	3.20	2.95
23	2.95	2.62	3.20	4.35	3.78	2.12	1.80	2.65	3.00	3.15	3.02
24	2.92	2.62	3.15	4.18	4.10	(a)	1.75	2.65	3.00	3.10	3.05
25	2.95	2.62	3.05	4.60	4.12	(a)	1.75	2.75	3.05	3.10	3.10
26	2.95	2.60	2.90	4.35	4.75	2.10	1.75	2.75	3.10	3.10	3.15
27	2.92	2.60	2.85	3.92	5.45	4.70	1.75	2.80	3.05	3.10	3.12
28	2.92	2.60	2.85	3.58	5.50	5.50	1.75	2.88	3.08	3.10	3.20
29	.....	2.52	3.18	3.35	5.42	5.45	1.75	2.98	3.10	3.10	3.18
30	.....	2.52	3.32	3.25	5.12	5.62	2.08	3.50	3.10	3.10	3.05
31	.....	2.52	.....	3.68	.....	5.28	2.42	.....	3.10	.....	2.95
1908.											
1	.....	.....	2.2	1.35	2.5	1.7	2.35	1.7	2.2	2.8	.....
2	.....	.....	2.2	1.35	2.0	1.6	1.85	1.7	2.2	2.7	.....
3	.....	.....	2.2	1.35	1.95	1.6	1.7	1.65	2.2	2.7	.....
4	.....	.....	2.2	.....	1.95	1.6	1.6	1.65	2.3	2.7	.....
5	.....	.....	2.15	1.85	1.8	1.6	1.6	1.65	2.3	2.7	.....
6	.....	.....	.....	2.25	1.7	1.6	1.6	1.65	2.4	2.7	.....
7	.....	.....	.....	2.25	1.6	1.6	1.65	1.65	2.4	2.65	.....
8	.....	.....	.....	2.45	1.55	1.6	1.95	1.7	2.45	2.6	.....
9	.....	.....	2.15	2.3	1.5	1.6	1.85	1.7	2.45	2.6	.....
10	.....	2.8	2.1	2.25	1.5	1.6	1.9	1.7	2.45	2.6	.....
11	.....	2.8	1.85	1.7	1.4	1.6	2.0	1.7	2.45	2.6	.....
12	.....	2.8	1.6	1.7	1.4	1.6	1.85	1.7	2.45	2.6	.....
13	.....	2.8	1.6	1.7	1.4	1.6	1.9	1.7	2.45	2.7	.....
14	.....	2.8	1.6	1.7	1.45	1.65	1.9	1.75	2.45	2.8	.....
15	.....	2.7	1.55	1.7	1.7	1.65	1.9	1.75	2.5	2.8	.....
16	.....	2.7	1.55	1.7	2.2	1.65	1.9	1.75	2.5	2.8	.....
17	.....	2.7	1.55	1.7	2.2	1.6	1.9	1.75	2.7	2.9	.....
18	.....	2.65	1.55	1.7	2.0	.....	1.9	1.75	2.9	2.9	.....
19	.....	2.6	1.55	1.7	1.9	1.8	2.25	1.75	3.0	2.9	.....
20	.....	2.6	1.5	1.7	1.9	2.0	2.2	1.75	3.1	2.9	.....
21	.....	2.6	1.4	1.6	2.0	2.0	2.25	1.8	3.15	2.9	.....
22	.....	2.5	1.45	1.6	1.95	1.9	2.6	1.75	3.3	2.9	.....
23	.....	2.4	1.45	1.6	1.8	1.8	2.75	1.75	3.0	2.85	.....
24	.....	2.4	1.3	1.9	1.8	1.6	2.8	1.8	3.0	2.8	.....
25	.....	2.4	1.3	2.65	1.8	1.6	2.3	1.8	2.9	2.8	.....
26	.....	2.4	1.3	2.5	1.75	1.6	2.2	1.9	2.9	2.8	.....
27	.....	2.4	1.3	2.4	1.75	1.6	2.05	2.05	2.9	2.7	.....
28	.....	2.35	1.3	2.4	1.75	1.6	1.9	2.2	2.85	2.8	.....
29	.....	2.3	1.35	2.4	1.7	1.6	1.75	2.2	2.85	2.9	.....
30	.....	2.3	1.35	2.25	1.7	1.6	1.7	2.2	2.85	3.0	.....
31	.....	2.2	.....	2.1	.....	3.3	1.7	.....	2.85	.....	.....

[a] No water under gage.

NOTE.—Probably ice conditions January 1 to February 12, 1907, January 1 to March 9, and December, 1908.

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Rating tables for South Platte River near Kersey, Colo. (gage No. 2).

FEBRUARY 1 TO MAY 6, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	245	2.20	290	2.70	370	3.20	520
1.80	250	2.30	305	2.80	390	3.30	5.0
1.90	260	2.40	320	2.90	415	3.40	605
2.00	270	2.50	335	3.00	445	3.50	655
2.10	280	2.60	350	3.10	480		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and is well defined between gage heights 2.5 feet and 3.0 feet.

MAY 7 TO JUNE 19, 1907.

[Indirect method for shifting channels used.]

JUNE 20 TO DECEMBER 31, 1907.

1.70	20	2.70	320	3.70	770	4.70	1,585
1.80	50	2.80	355	3.80	835	4.80	1,690
1.90	80	2.90	390	3.90	905	4.90	1,800
2.00	110	3.00	425	4.00	980	5.00	1,920
2.10	140	3.10	465	4.10	1,055	5.20	2,175
2.20	170	3.20	510	4.20	1,135	5.40	2,455
2.30	200	3.30	555	4.30	1,215	5.60	2,770
2.40	230	3.40	605	4.40	1,300		
2.50	260	3.50	655	4.50	1,390		
2.60	290	3.60	710	4.60	1,485		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during this period and is not well defined.

MARCH 10 TO NOVEMBER 30, 1908.

1.30	30	1.90	89	2.50	209	3.10	373
1.40	36	2.00	105	2.60	233	3.20	410
1.50	43	2.10	122	2.70	257	3.30	450
1.60	52	2.20	142	2.80	281		
1.70	63	2.30	163	2.90	308		
1.80	75	2.40	185	3.00	338		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during 1908 and is fairly well defined between gage heights 1.4 feet and 2.8 feet.

Daily discharge, in second-feet, of South Platte River near Kersey, Colo. (gage No. 2), May 7 to June 19, 1907.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1	.....	1,740	11	1,120	1,040	21	1,400	.....
2	.....	1,620	12	1,120	615	22	1,360	.....
3	.....	1,620	13	1,480	520	23	1,600	.....
4	.....	2,000	14	1,560	630	24	1,420	.....
5	.....	1,600	15	1,780	960	25	1,360	.....
6	.....	1,440	16	1,700	1,210	26	1,600	.....
7	920	1,700	17	1,560	1,280	27	1,200	.....
8	1,040	1,650	18	1,420	1,120	28	940	.....
9	1,070	1,460	19	1,520	790	29	790	.....
10	1,090	1,520	20	1,400	.....	30	720	.....
						31	1,010	.....

NOTE. –These discharges were obtained by the indirect method for shifting channels.

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Monthly discharge of South Platte River near Kersey, Colo., for 1907 and 1908.

[Drainage area, 9,470 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
February 13–28	730	646	677	0.071	0.04	21,500	A.
March	654	518	568	.060	.07	34,900	A.
April	955	350	550	.058	.06	32,700	B.
May	2,790	822	1,790	.189	.22	110,000	B.
June	4,330	835	2,240	.237	.26	133,000	B.
July	4,540	195	1,770	.187	.22	109,000	A.
August	3,540	121	790	.083	.10	48,600	B.
September	905	150	376	.040	.04	22,400	B.
October	915	645	759	.080	.09	46,700	A.
November	825	695	767	081	.09	45,600	A.
December	790	610	707	.075	.09	43,500	B
The period						648,000	
1908.							
March 10–31	446	217	339	.036	.03	14,800	A.
April	240	67	127	.013	.01	7,560	A.
May	465	70	166	.018	.02	10,200	A.
June	265	78	128	.014	.02	7,620	A.
July	800	94	128	.014	.02	7,870	A.
August	421	94	176	.019	.02	10,800	A.
September	217	104	128	.014	.02	7,620	A.
October	817	212	399	.042	.05	24,500	A.
November	558	351	434	.046	.05	25,800	A.
The period						117,000	

NOTE.—These discharges represent the combined flow of the two channels. Discharge estimated for each channel for days on which the gage was not read.

SOUTH PLATTE RIVER NEAR JULESBURG, COLO.

This station, which is located 1 mile south of Julesburg, Colo., in T. 12 N., R. 44 W., below all irrigation ditches taking water from the South Platte in Colorado except one, was established April 2, 1902, but was not in operation during 1907. It was reestablished on May 12, 1908, at a new pile bridge about 2,000 feet upstream from the old location.

The greatest value of this station lies in the fact that it is situated less than a mile from the Colorado-Nebraska line, and its records therefore show the amount of water passing into Nebraska. It has also some importance in obtaining data on the flow of return waters.

All the tributaries for 100 miles or more above the station are intermittent streams and none are of any importance. The same may be said of the tributaries between Julesburg and North Platte, where the river joins North Platte River to form the Platte. The drainage area at Julesburg is 20,600 square miles. Numerous irrigation systems and reservoirs are located on the South Platte and tributaries above Julesburg for a distance of 250 miles. In 1907 more than 900,000 acres were irrigated in this valley. Nearly 450,000 acre-feet were stored in reservoirs, and over half of this quantity was used for

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irrigation in that year. Additional rights can not be provided for in the South Platte Valley without constructing reservoirs to store surplus flood waters.

The flow of the river at Julesburg during the irrigation season depends on the amount of water diverted above and is likely to be small except when the river is in flood. During the nonirrigating season considerable water is diverted by feeder canals to storage reservoirs from the main river or its tributaries or is intercepted by reservoirs on the tributaries.

The river is usually frozen over wholly or in part for two or three months during the winter.

When the station was reestablished in 1908 the gage was moved 2,000 feet upstream and it is in no way referred to the old gage. However, the recorded gage heights give no indication of the discharge of the river from one season to the next because of the sandy and extremely shifting character of the stream bed. In low water the river consists of a number of small rivulets flowing between sand bars. In order to procure reliable results measurements should be taken as often as once every two weeks throughout the year.

Discharge measurements of South Platte River near Julesburg, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				Old gage.	New gage.	
		Feet.	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
May 12	W. B. Freeman	56	24	1.35	1.30	29
June 10	do	191	38	1.48	1.34	45
July 22	J. B. Stewart	.....	.....	1.38	1.22	36
August 21[a]	do	132	47	.....	1.33	64
November 2	do	142	88	1.65	1.45	140

[a] Made by wading.

Daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1908.

[Mrs. W. K. Green and Miss May C. Wood, observers.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.3	1.3	1.3	1.2	.....	.....	.....
2	.....	1.3	1.3	1.2	1.3	.....	1.45	.....
3	.....	1.2	1.2	1.2	1.3	.....	1.4	.....
4	.....	1.2	1.2	1.2	1.2	.....	1.4	1.65
5	.....	1.2	1.3	1.2	1.3	.....	1.35	1.7
6	.....	1.2	1.4	1.3	1.3	.....	1.4	.....
7	.....	1.2	1.3	1.3	1.3	.....	1.4	2.1
8	.....	1.2	1.3	1.2	1.2	.....	.....	.....
9	.....	1.2	1.2	1.3	1.2	.....	.....	2.3
10	.....	1.35	1.2	1.2	1.2	.....	.....	.....
11	.....	1.3	1.1	1.3	1.2	.....	.....	2.3
12	1.3	1.2	1.3	1.2	1.4	.....	.....	2.2
[illegible]	1.4	1.3	1.2	1.2	1.2	.....	1.4	.....
[illegible]	1.6	1.2	1.3	1.3	1.2	.....	.....	2.4
[illegible]	1.5	1.2	1.3	1.2	1.2	.....	.....	.....

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Daily gage height, in feet, of South Platte River near Julesburg, Colo., for 1908—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.5	1.5	1.2	1.3	1.3	.....	1.45	.....
17	1.5	1.55	1.2	1.3	1.2	.....	1.45	2.5
18	1.5	1.5	1.3	1.4	1.2	.....	1.45	2.4
19	1.4	1.4	1.4	1.4	1.2	.....	1.5	.....
20	1.5	1.4	1.3	1.3	1.2	.....	1.5	.....
21	1.5	1.4	1.2	1.3	1.2	.....	1.55	2.15
22	1.3	1.2	1.4	1.4	1.2	.....	.....	.....
23	1.3	1.3	1.5	1.3	1.2	.....	1.6	1.95
24	1.5	1.3	1.4	1.4	1.2	.....	1.6	2.0
25	1.5	1.2	1.35	1.3	1.2	.....	1.6	.....
26	1.9	1.4	1.3	1.3	1.2	.....	1.5	.....
27	1.8	1.2	1.3	1.3	1.2	.....	.....	.....
28	1.6	1.2	1.4	1.25	1.3	.....	.....	.....
29	1.5	1.2	1.3	1.3	1.2	.....	.....	.....
30	1.5	1.2	1.4	1.3	1.2	.....	1.4	.....
31	1.4	.....	1.3	1.2	.....	.....	.....	.....

NOTE.—Probable ice conditions during December.

Rating tables for South Platte River near Julesburg, Colo.

MAY 12 TO JUNE 10, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	12	1.40	70	1.60	240	1.80	500
1.30	29	1.50	140	1.70	360	1.90	660

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on two discharge measurements made during May and June and is not well defined.

JUNE 11 TO DECEMBER 31, 1908.

1.10	20	1.30	54	1.50	188	1.60	307
1.20	32	1.40	102				

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during this period and is fairly well defined.

Monthly discharge of South Platte River near Julesburg, Colo., for 1908.

[Drainage area, 20,600 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
May 12–31	660	29	167	0.0081	0.006	6,620	C.
June	248	12	57.6	.0028	.003	3,430	B.
July	188	20	61.6	.0030	.003	3,790	B.
August	102	32	52.7	.0026	.003	3,240	B.
September	102	32	39.5	.0019	.002	2,350	B.
November	307	78	154	.0075	.008	9,160	C.

NOTE.—Discharge interpolated for missing days in November.

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NORTH FORK OF SOUTH PLATTE RIVER AT CASSELLS, COLO.

This station, which is located at Cassells, Colo., was established July 4, 1908, to determine the value of the stream for power development.

Geneva Creek, one of the most important tributaries, comes in about 2 miles above, and supplies a large part of the water passing the station.

The drainage area above the station comprises about 100 square miles, a considerable part of which is timbered. No diversions of any importance are made above this point on the main stream or any of its tributaries, but many filings have been made for power sites, especially on Geneva Creek. Additional power sites are, however, probably available.

The stream is liable to freeze over from the middle of November to the 1st of April.

No change has been made in the datum of the gage since it was first established.

Very good results should be obtained except in extremely high water. Measurements can be taken by wading the greater part of the year. Frequent measurements are necessary to determine the winter flow accurately.

Discharge measurements of North Fork of South Platte River at Cassells, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	Freeman and Stewart	28.5	52	1.37	89
July 4	J. B. Stewart	28.5	55	1.30	78
September 5	do	29	47	1.05	37
October 27	do	29	55	1.30	[a] 29
December 15 [b]	W. B. Freeman	9.5	17.3	1.44	13.4
December 16 [b]	do	11	22.4	1.47	18.6
December 30 [b]	do	16.7	12.3	1.10	15.1
December 31 [b]	do	16.5	11.6	1.10	12.8

[a] Discharge probably low. Some ice. [b] Made by wading. Ice conditions.

Daily gage height, in feet, of North Fork of South Platte River at Cassells, Colo., for 1908.

[Lulu Cassell, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.2	.....	1.15	1.2	0.7	16	1.45	1.2	.....	1.05	1.1	1.45
2		1.2	.....	1.1	1.1	.8	17	1.25	1.25	.....	1.1	1.2	1.45
3		1.25	.....	1.1	1.15	.8	18	1.3	1.2	.....	1.0	1.2	1.45
4	1.3	1.2	1.1	1.1	1.2	.8	19	1.25	1.2	.....	.9	1.2	1.3
5	1.2	1.25	.....	1.1	1.1	.75	20	1.2	1.3	.....	1.0	1.1	1.35
6	1.2	1.2	.....	1.05	1.2	.8	21	1.3	1.2	.....	1.3	1.1	1.3
7	1.3	1.15	.....	1.1	1.05	.9	22	1.2	1.3	.....	1.3	1.1	1.3
8	1.2	1.25	.....	1.1	1.1	.8	23	1.2	1.3	.....	1.25	1.0	1.2
9	1.15	1.15	.....	1.1	1.2	.7	24	1.15	1.2	.....	1.25	1.1	1.15
10	1.15	1.2	.....	1.1	1.2	.9	25	1.25	1.2	.....	1.15	1.1	1.1
[illegible]	1.2	1.2	.....	1.1	1.2	1.3	26	1.2	1.15	.....	1.2	.9	1.1
[illegible]	1.25	1.2	.....	1.1	1.0	1.4	27	1.1	1.25	.....	1.3	.8	1.1
[illegible]	.3	1.3	.....	1.05	1.0	1.4	28	1.2	1.2	.....	1.3	.8	1.1
[illegible]	.3	1.3	.....	1.0	1.0	1.45	29	1.3	1.3	.....	1.25	.9	1.05
[illegible]	.25	1.2	.....	1.0	1.0	1.45	30	1.2	1.25	.....	1.2	.9	1.1
							31	1.3	1.2	.....	1.2	.....	1.1

[illegible]ditions November 15 to December 31, 1908.

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Rating table for North Fork of South Platte River at Cassells, Colo., for July 1 to August 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	21	1.10	45	1.30	77	1.50	113
1.00	31	1.20	61	1.40	95		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on three discharge measurements made during July and August, 1908, and is well defined between gage heights 1.0 foot and 1.4 feet.

Monthly discharge of North Fork of South Platte River at Cassells, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July	104	45	68.4	4,210	A.
August	77	53	64.9	3,990	A.
December	21	13	15.5	953	C.

NOTE.—December estimated on account of ice conditions.

GENEVA CREEK NEAR GRANT, COLO.

This station, which is located at Sullivan's ranch, 3½ miles above Grant, Colo., in T. 6 S., R. 74 W., was established July 5, 1908, to obtain data concerning the run-off from a small mountain drainage area and also to determine the flow available for power development.

The station is about 3½ miles above the confluence of Geneva Creek with the North Fork of the South Platte, about 50 feet below the mouth of Gold Run, or Threemile Creek, and about a mile below the mouth of Scott Gomer Gulch, which is called on some of the old maps the North Fork of the South Platte. The drainage area, which is very mountainous and part of which area is heavily timbered, comprises 49 square miles above the station.

No water is diverted above the station. Several power sites have been filed on, but the stage of construction at none of these has yet been reached. The creek has a fall of 900 feet in the last 4 miles, and a very much greater fall above. With proper storage it will be possible to develop 10,000 horsepower during a six months' period. The development of the Continental reservoir site, about 3 miles above the station, is under consideration.

The creek is frozen wholly or in part for four or five months during the year.

The datum of the gage has not been changed since the station was established.

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Very good results should be obtained except at very high stages, when the current is likely to be swift. Measurements can be made by wading at most seasons of the year, but for flood measurements a cable must be installed.

Discharge measurements of Geneva Creek near Grant, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 7	Freeman and Stewart	24	34	0.65	70
July 5	J. B. Stewart	29	32	.60	50
September 4	do	25	25.2	.48	32
October 25	do	23	26	.48	29
December 15[a]	W. B. Freeman	11.5	15.8	.35	14.6
December 28[a]	do	11	9.8	.20	11.2
December 29[a]	do	13	10.6	.20	14.1

[a] Ice conditions.

NOTE.—All measurements made by wading.

Daily gage height, in feet, of Geneva Creek near Grant, Colo., for 1908.

[J. Bruce Mather and Edward Sullivan, observers.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	0.65	0.5	0.45	0.5	16	0.7	0.7	0.5	0.4	.....
2	.....	.65	.55	.4	.4	17	.7	.7	.5	.4	.....
3	.....	.6	.55	.4	.4	18	.65	.8	.45	.4	.....
4	.....	.6	.6	.35	.4	19	.7	.75	.4	.4	.....
5	0.6	.6	.55	.35	.45	20	.65	.7	.4	.45	.....
6	.65	.7	.5	.35	.4	21	.75	.7	.4	.4	.....
7	.6	.65	.45	.4	.45	22	.65	.6	.4	.5	.....
8	.6	.6	.5	.35	.4	23	.65	.6	.4	.4	.....
9	.7	.6	.45	.4	.4	24	.65	.6	.4	.4	.....
10	.7	.6	.5	.4	.5	25	.6	.6	.4	.4	.....
11	.7	.6	.4	.4	.4	26	.5	.55	.5	.4	.....
12	.7	.6	.4	.4	.5	27	.5	.6	.4	.4	.....
13	.65	.65	.5	.4	.45	28	.5	.55	.45	.4	.....
14	.7	.65	.5	.4	.4	29	.5	.5	.4	.4	.....
15	.7	.6	.55	.35	.5	30	.65	.55	.4	.45	.....
						31	.65	.55	.....	.5	.....

NOTE.—Ice conditions November 15 to December 31.

Rating table for Geneva Creek near Grant, Colo., for July 1 to November 14, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	14	0.50	33	0.70	81
.40	21	.60	54	.80	112

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seven discharge measurements made during 1908, and is fairly well defined between gage heights 0.30 foot and 0.65 foot.

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Monthly discharge of Geneva Creek near Grant, Colo., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July	96	33	64.3	3,950	B.
August	112	33	61.6	3,790	B.
September	54	21	29.3	1,740	A.
October	33	17	21.6	1,330	A.
November	33		21.3	1,270	C.
December			14.3	879	C.
The period				13,000	

NOTE.—Discharge estimated for period July 1-4. Discharges for frozen period, November 15 to December 31, have been estimated on the basis of three measurements.

CLEAR CREEK AT FORKSCREEK, COLO.

This station, which is located at Forkscreek, Colo., in T. 3 S., R. 71 W., was established May 29, 1899, to determine the amount of water available for irrigation and power development.

The station is a few hundred feet below the mouth of the North Fork. No other important tributaries enter between this fork and the mouth of the stream. For 13 miles below the station the creek flows in a deep canyon, falling in that distance 1,225 feet. It then emerges into a broad valley, where the entire normal flow is used for irrigation. The drainage area above the station comprises a narrow strip of very mountainous country, composed entirely of granitic rock, in many places barren of soil and studded with heavy patches of coniferous timber, remnants of a once extensively forested area. This area is 345 square miles.

Two of the oldest mining districts in Colorado lie in this basin, and in these districts the waters of the upper tributaries of the stream have been used for mining. The stream now carries in suspension immense quantities of tailings and sediment, and the name Clear Creek has long been a misnomer.

The water is used to some extent for power, and 4,000 horsepower are at present developed by about a dozen small plants. Several other plants are planned or in the course of construction. By utilizing all the storage facilities on the stream above Forkscreek it will be possible to develop about 30,000 horsepower for six months during the year, and 20,000 more between that point and its mouth.

The natural flow of the stream is more or less affected by storage in various ponds and reservoirs above. The creek is frozen over for three or four months during the winter.

On July 19, 1905, the gage was moved 30 feet upstream from its original location, but it is not likely that the relation of gage heights was materially affected thereby. Very good results should be ob-

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tained at this station except in times of high water, when it is very difficult to measure on account of the swiftness of the current. As the channel is occasionally shifted by floods, new rating curves must from time to time be constructed.

The creek is subject to disastrous floods, due to the heavy rains in summer months, which frequently wash out the tracks of the Colorado and Southern Railway in the bottom of the canyon.

About December 1, 1908, the Denver Reservoir and Irrigation Company established a station about 2 miles above Golden and 10 miles below Forkscreek, and discharges for December are based on records at this station.

Discharge measurements of Clear Creek at Forkscreek, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 15[a]	C. L. Chatfield	22	21	1.90	35
March 16	do	27	22	1.98	35
Do	do	28	28	2.10	49
April 11	do	33	44	2.70	120
April 23	do	30	46	2.75	134
May 10	do	32	52	2.90	177
June 3	W. B. Freeman	36	90	3.77	562
June 18	do	36	136	4.77	1,070
July 19	do	42	110	5.53	553
August 9	do	37	74	5.00	314
September 9	do	28.5	52	4.57	158
October 11	Freeman and Stewart	27.5	41	4.40	100
December 5	J. B. Stewart	25	31	4.05	49
1908.					
February 20[b]	J. B. Stewart	14	27	5.22	63
March 16	do	30	16	4.00	41
May 21	do	34	58	4.88	247
June 17	do	44	104	5.88	525
August 15	do	39	48	5.20	172
October 30	do	38	29	5.02	78
December 11[b]	W. B. Freeman	28	43	5.37	48
Do[b]	do	21	42	5.46	51

[a] Ice conditions. [b] Measured by wading; ice conditions.

Discharge measurements of Clear Creek near Golden, Colo., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 4	S. Krajicek	30	40	0.43	64
December 12	do	30	27.4	.02	37
Do	W. B. Freeman	20	31	.02	36
December 28	S. Krajicek			1.42	65

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Daily gage height, in feet, of Clear Creek near Forkscreek, Colo., for 1907 and 1908.

[C. W. Hoisington, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.												
1	.....	.....	.....	2.45	2.85	3.65	4.95	5.30	4.70	4.45	4.28	.....
2	.....	.....	.....	2.43	2.70	3.75	5.00	5.30	4.70	4.45	4.25	.....
3	.....	.....	.....	2.45	2.80	3.88	4.95	5.25	4.70	4.48	4.25	.....
4	.....	.....	.....	2.53	2.83	3.90	4.95	5.22	4.65	4.45	4.28	.....
5	.....	.....	.....	2.50	2.80	4.00	4.90	5.15	4.65	4.45	4.25	4.05
6	.....	.....	.....	2.50	2.75	4.22	4.80	5.10	4.60	4.45	4.25	.....
7	.....	.....	1.83	2.47	2.85	4.25	4.75	5.05	4.60	4.58	4.22	.....
8	.....	.....	1.85	2.47	2.85	4.30	4.75	5.00	4.55	4.55	4.22	.....
9	.....	.....	1.87	2.47	2.93	4.20	[a]5.50	5.00	4.55	4.45	4.22	.....
10	.....	.....	1.93	2.60	2.90	4.15	6.15	5.00	4.55	4.42	4.15	.....
11	.....	.....	2.00	2.77	3.13	4.22	5.85	4.95	4.52	4.40	3.70	.....
12	.....	.....	2.05	2.70	3.20	4.38	5.85	4.90	4.50	4.40	3.80	.....
13	.....	.....	2.07	2.70	3.33	4.48	5.85	4.90	4.45	4.40	3.85	.....
14	.....	.....	2.03	2.77	3.27	4.60	5.90	4.88	4.40	4.40	3.85	.....
15	.....	.....	1.97	2.85	3.30	4.72	5.78	4.90	4.45	4.40	3.85	.....
16	.....	.....	2.00	3.00	3.37	4.80	5.65	4.85	4.45	4.35	3.85	.....
17	.....	.....	2.33	2.93	3.37	4.62	5.60	4.80	4.45	4.35	.....	.....
18	.....	.....	2.35	2.85	3.45	4.82	5.55	4.75	4.45	4.35	.....	.....
19	.....	.....	2.37	2.80	3.60	4.98	5.52	4.75	4.45	4.30	.....	.....
20	.....	.....	2.43	2.77	3.80	4.58	5.48	4.78	4.45	4.30	.....	.....
21	.....	.....	2.47	2.80	3.97	4.58	5.35	4.80	4.45	4.30	.....	.....
22	.....	.....	2.43	2.83	4.23	4.55	5.35	4.75	4.45	4.30	.....	5.60
23	.....	.....	2.40	2.80	4.23	4.68	5.55	4.70	4.45	4.30	.....	5.60
24	.....	.....	2.37	2.80	4.20	4.75	5.55	4.70	4.25	4.30	.....	5.05
25	.....	.....	2.37	2.83	4.05	4.95	5.52	4.85	4.28	4.30	.....	4.95
26	.....	.....	2.47	2.60	3.90	4.98	5.82	4.75	4.42	4.30	.....	4.85
27	.....	.....	2.47	2.77	3.83	5.05	5.70	4.75	4.48	4.30	.....	4.70
28	.....	.....	2.45	2.70	3.75	5.05	5.60	4.70	4.42	4.30	.....	4.55
29	.....	.....	2.25	2.83	3.70	4.95	5.50	6.85	4.45	4.30	.....	4.35
30	.....	.....	2.30	2.95	3.63	4.98	5.38	4.78	4.42	4.28	.....	4.85
31	.....	.....	2.33	.....	3.60	.....	5.38	4.70	.....	4.28	.....	4.95
1908.												
1	4.9	5.45	4.0	3.9	4.1	5.0	5.5	5.4	5.1	5.0	5.0	5.6
2	4.85	5.45	4.1	3.75	4.3	5.2	5.35	5.4	5.1	5.0	5.0	5.65
3	4.75	5.4	4.1	3.7	4.5	5.3	5.35	5.3	5.1	5.0	5.0	5.8
4	4.95	5.3	4.0	3.9	4.55	5.5	5.35	5.2	5.1	5.0	5.0	5.65
5	5.0	5.25	4.0	3.8	4.6	5.4	5.35	5.2	5.1	5.0	5.0	5.5
6	4.9	5.2	4.0	3.8	4.6	5.4	5.35	5.2	5.1	5.0	5.0	5.4
7	5.15	5.2	3.85	4.2	4.6	5.3	5.3	5.25	5.1	5.0	5.0	5.5
8	5.2	5.2	3.85	3.9	4.55	5.25	5.3	5.2	5.1	5.0	5.0	5.6
9	5.3	5.2	3.75	3.95	4.65	5.3	5.3	5.2	5.1	5.0	5.0	5.55
10	5.4	5.3	3.9	4.0	4.55	5.6	5.3	5.2	5.1	5.0	5.0	5.45
11	5.35	5.3	3.85	4.15	4.55	5.8	5.3	5.2	5.1	5.0	4.9	5.4
12	5.35	5.2	3.95	4.2	4.6	5.9	5.25	5.25	5.1	4.9	5.0	5.3
13	5.35	5.2	3.95	4.4	4.55	5.7	5.3	5.2	5.1	4.9	4.95	5.35
14	5.45	5.15	3.95	4.4	4.5	5.8	5.25	5.2	5.1	4.9	4.95	5.3
15	5.45	5.2	4.0	4.4	4.6	5.9	5.25	5.2	5.2	4.9	5.05	5.35
16	5.35	5.15	4.05	4.5	4.6	5.75	5.25	5.2	5.15	4.95	5.2	5.4
17	5.35	5.15	4.15	4.5	4.65	5.9	5.25	5.5	5.1	5.0	5.3	5.3
18	5.45	4.95	4.15	4.5	4.7	5.7	5.2	5.4	5.1	4.95	5.2	5.5
19	5.4	4.95	4.0	4.25	4.8	5.5	5.1	5.4	5.1	4.95	5.2	5.6
20	5.35	5.2	3.9	4.35	5.05	5.45	5.1	5.5	5.1	4.95	5.2	5.7
21	5.3	5.15	3.85	4.5	4.9	5.5	5.1	5.65	5.1	4.95	5.2	5.75
22	5.3	4.95	3.85	4.6	4.9	5.7	5.1	5.8	5.1	4.95	5.2	5.65
23	5.2	4.8	3.85	4.7	4.9	5.6	5.05	5.4	5.1	5.0	5.1	5.8
24	5.35	4.5	3.8	4.6	5.0	5.65	5.05	5.4	5.0	5.0	5.0	5.9
25	5.2	4.7	3.9	4.55	5.0	5.6	5.0	5.35	5.0	4.95	4.9	5.85
26	5.15	4.95	3.8	4.45	5.0	5.6	4.9	5.3	5.1	4.95	4.9	5.75
27	5.15	4.75	4.0	4.3	4.95	5.65	4.85	5.3	5.15	4.95	5.0	5.7
28	5.2	4.2	3.95	4.4	4.9	5.65	4.85	5.2	5.1	5.0	5.2	5.6
29	5.1	4.0	3.8	3.85	4.85	5.5	4.9	5.2	5.0	5.0	5.3	5.55
30	5.0	.....	4.0	4.1	4.85	5.2	5.1	5.2	5.0	5.0	5.45	5.35
31	5.1	.....	3.95	.....	4.8	.....	5.0	5.15	.....	5.0	.....	5.0

[a] Maximum gage height was 9.2 feet.

NOTE.—Ice conditions January 1–March 6, 1907; November 17, 1907, to February 27, 1908, and after November 14, 1908.

31260—IRR 246—10——18

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Rating tables for Clear Creek at Forkscreek, Colo.

MARCH 7 TO JULY 9, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	28	2.70	119	3.60	423	4.50	895
1.90	32	2.80	142	3.70	469	4.60	951
2.00	37	2.90	169	3.80	517	4.70	1,009
2.10	44	3.00	199	3.90	568	4.80	1,068
2.20	52	3.10	231	4.00	622	4.90	1,129
2.30	61	3.20	265	4.10	676	5.00	1,192
2.40	72	3.30	301	4.20	730	5.20	1,321
2.50	85	3.40	339	4.30	785	5.40	1,453
2.60	100	3.50	380	4.40	840	5.60	1,587

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during this period and is well defined between gage heights 1.8 feet and 4.8 feet.

JULY 10, 1907, TO MAY 20, 1908.

3.70	23	4.40	103	5.10	351	5.80	676
3.80	29	4.50	133	5.20	394	5.90	724
3.90	36	4.60	165	5.30	439	6.00	773
4.00	43	4.70	199	5.40	485	6.10	823
4.10	52	4.80	234	5.50	532	6.20	873
4.20	63	4.90	271	5.60	580		
4.30	80	5.00	310	5.70	628		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on six discharge measurements made during this period and is well defined between gage heights 4.0 feet and 5.7 feet.

MAY 21 TO NOVEMBER 20, 1908.

[Indirect method for shifting channels used.]

Daily discharge, in second-feet, of Clear Creek at Forkscreek, Colo., for 1908.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	268	350	280	130	92	74	58
2	.....	328	290	270	130	92	74	58
3	.....	370	285	230	130	92	74	58
4	.....	460	285	195	130	92	74	64
5	.....	410	285	195	130	92	74	65
6	.....	400	285	195	130	92	74	64
7	.....	365	265	212	130	92	74	50
8	.....	335	265	188	125	84	74	55
9	.....	332	260	188	125	84	74	53
10	.....	460	260	188	125	84	74	58
11	.....	550	260	188	125	84	60	50
12	.....	600	242	204	125	67	74	48
13	.....	460	260	188	125	67	66	48
14	.....	510	242	172	125	67	66	49
15	.....	550	236	172	155	67	70	54
16	.....	470	236	172	138	76	70	55
17	.....	535	236	284	125	84	70	61
18	.....	445	220	245	125	76	65	52
19	.....	360	182	245	125	76	65	42
20	.....	340	182	284	125	76	65	49
21	250	355	176	340	125	76	65	65
22	250	440	176	405	125	76	65	65
23	240	395	158	245	114	74	65	67
24	280	415	158	235	92	74	65	67
25	280	395	142	215	92	66	60	66
26	264	395	115	198	114	66	60	77
27	246	412	100	198	126	66	60	79
28	228	412	100	162	114	74	60	71
29	210	350	110	162	92	74	60	58
30	214	232	170	162	92	74	60	41
.....	195	.....	138	146	.....	74	.....	48

scharges were obtained by the indirect method for shifting channels, May 21 to Novem-
ted November 15 to 30; and are from records kept by the Denver Reservoir and Irriga-
station 2 miles above Golden for December.

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Monthly discharge of Clear Creek at Forkscreek, Colo., for 1907 and 1908.

[Drainage area, 345 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 7-31	81	29	56.7	0.164	0.15	2,810	B.
April	199	76	124	.359	.40	7,380	A.
May	746	119	363	1.05	1.21	22,300	A.
June	1,220	446	903	2.62	2.92	53,700	A.
July	1,520	462	760	2.20	2.54	46,700	A.
August	439	199	277	.803	.93	17,000	A.
September	199	72	134	.388	.43	7,970	A.
October	159	77	99.3	.288	.33	6,110	A.
November 1-16	77	32	54.9	.159	.09	1,740	B.
The period						166,000	
1908.							
January			50	.145	.17	3,070	D.
February			55.2	.160	.17	3,180	D.
March	58	26	39.5	.114	.13	2,430	B.
April	199	23	85.0	.246	.27	5,060	A.
May	330	52	191	.554	.64	11,700	A.
June	600	232	412	1.19	1.33	24,500	B.
July	350	100	215	.623	.72	13,200	B.
August	405	146	218	.632	.73	13,400	B.
September	155	92	122	.354	.40	7,260	B.
October	92	66	78.4	.227	.26	4,820	B.
November			67.7	.196	.22	4,030	D.
December			58.0	.168	.19	3,570	D.
The year			133	.384	5.23	96,200	

NOTE.—Discharge estimated January 1 to February 27, 1908, and November 15 to December 31, 1908.

BOULDER CREEK AT ORODELL, COLO.

This station, which was established March 18, 1907, is located just above the mouth of Fourmile Creek, about 4 miles above Boulder, Colo. The records are valuable chiefly in connection with power development. Boulder Creek has an immense amount of fall, and the distance from the Continental Divide at its headwaters to the plains at Boulder is only 20 miles.

No diversions are made above the station. The first canal has its intake a short distance below.

The creek is frozen four or five months of the year and discharges for such periods have been obtained by interpolation between discharge measurements and weir records.

The records at this station since May 20, 1907, have been kept and furnished by the Central Colorado Power Company.

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Discharge measurements of Boulder Creek at Orodell, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 19[a]	C. L. Chatfield	31	31	1.90	37
April 12[a]	do	37	44	2.15	58
April 22	do	34	37	2.04	44
Do	do	37	52	2.40	89
May 14	do	30	70	2.80	[b] 199
June 3	R. I. Meeker			3.20	[b] 334
June 13	do			3.35	[b] 409
July 3	do			3.82	[b] 605
July 13	do			3.58	[b] 503
August 25[a]	Meeker and Chatfield	37	45	2.33	93
September 3[a]	C. L. Chatfield	46	52	2.31	100
September 7[a]	do	44	47	2.13	78
September 21[a]	do	45	49	2.25	76
October 5[a]	do	38	34	1.93	36
October 6[a]	do	37	34	1.92	36
October 14[a]	do	31	30	1.82	26
October 18[a]	do	31	28	1.78	22
October 31[a]	do	31	30	1.84	27
November 10	R. I. Meeker	24	24.4	1.68	17.5
November 16[c]	do	22	29	2.03	19.4
November 23[c]	do	20	23.7	2.02	14.6
November 30[c]	do	17	17.0	1.80	14.7
December 6[c]	do	19	13.5	1.50	10.0
December 14[c]	do	18	19.1	1.70	7.7
December 24[c]	do	10	8.3		6.4
1908.					
January 12	R. I. Meeker	9	9.6		[d] 6.1
January 17	do	5.5	7.0		[e] 5.1
January 19	do	5.5	4.6		5.8
Do.[a]	do		5.9		6.5
February 20	do	6.0	4.6		4.8
March 14[a]	C. L. Chatfield	29	21.3	1.57	11.8
March 21	do	29	21.3	1.49	[f] 10.0
March 28	do	29	21.1	1.49	9.8
April 22	do	37	50	2.32	86
June 29	do	45	72	2.75	186
Do	do			2.75	[b] 185
July 15	do	45	70	2.72	180
August 1	do	47	67	2.68	[g] 194
August 13	do	42.5	56	2.52	134
September 2	do	37.5	44	2.22	76
November 2	do	30	22	1.64	16.5
November 20[c]	do	27.5	22.6	1.62	15.2
December 7[c]	do	23	13.7	1.82	11.3
December 8[h]	do	13	14.3	[i] .74	13.4
Do	do				[b] 15.28
December 28[h]	do	13	10.6	[i] .52	8.2
December 29[h]	do	13	10.0	[i] .47	7.3

[a] Made by wading.
[b] Measurement made at Ninth street bridge, Boulder, and the algebraic sum of all inflow and diversions between it and the Orodell station added.
[c] Ice conditions.
[d] Discharge over weir at power house gave 3.28 second-feet.
[e] Discharge over weir at power house gave 3.03 second-feet.
[f] Discharge over weir at power house gave 5.8 second-feet.
[g] Results rough. Poor measuring section.
[h] Measurement made at temporary station at power house.
[i] Gage at power house.

Daily gage height, in feet, of Boulder Creek at Orodell, Colo., for 1907 and 1908.

[Mrs. W. Laffea, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
1		1.85	2.38	3.00	3.95	2.98	2.42	2.06		1.55
2		1.85	2.42	3.12	3.92	2.95	2.38	2.10		
3		1.95	2.40	3.22	3.88	2.92	2.34	1.92	1.74	
		2.05	2.45	3.18	3.85	3.00	2.30	1.87	1.73	
		1.98	2.45	3.35	3.80	2.85	2.33	1.88	1.70	
		1.95	2.42	3.48	3.80	2.80	2.32	1.91	1.71	1.48
		1.88	2.45	3.48	3.80	2.80	2.20	2.05	1.69	
		1.90	2.55	3.50	3.78	2.82	2.22	1.98	1.69	
		1.95	2.60	3.40	3.70	2.80	2.20	1.90	1.68	
		2.00	2.65	3.22	3.65	2.78	2.13	1.87	1.66	

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Daily gage height, in feet, of Boulder Creek at Orodell, Colo., for 1907 and 1908—Cont'd.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.										
11	.....	2.25	2.78	3.25	3.60	2.75	2.09	1.87	.....	.....
12	.....	2.18	2.90	3.35	3.50	2.75	2.08	1.85	.....	.....
13	.....	2.15	2.98	3.42	3.58	2.60	2.08	1.83	.....	.....
14	.....	2.25	2.88	3.58	3.62	2.58	2.13	1.82	.....	.....
15	.....	2.30	2.85	3.70	3.52	2.65	2.12	1.83	.....	.....
16	.....	2.32	2.82	3.65	3.35	2.65	2.10	1.81	.....	.....
17	.....	2.32	2.95	3.58	3.10	2.55	2.07	1.80	.....	.....
18	1.75	2.28	3.00	3.72	3.12	2.60	2.05	1.78	.....	.....
19	1.98	2.15	3.20	3.70	3.15	2.65	2.04	1.87	.....	.....
20	1.95	2.15	3.35	3.55	3.20	2.62	2.07	1.84	.....	.....
21	2.00	2.20	3.35	3.58	3.30	2.52	2.25	1.82	1.71	.....
22	2.00	2.20	3.35	3.60	3.22	2.45	2.21	1.78	.....	.....
23	2.00	2.28	3.35	3.58	3.18	2.35	2.09	1.78	.....	.....
24	1.95	2.35	3.35	3.65	3.15	2.35	1.81	1.81	.....	.....
25	2.00	2.32	3.30	3.68	3.12	2.38	1.80	1.87	1.60	.....
26	2.05	2.32	3.05	3.60	3.55	2.55	1.88	.....	1.57	.....
27	2.02	2.42	2.92	3.60	3.48	2.60	2.13	.....	1.57	.....
28	1.95	2.48	2.92	3.65	3.58	2.55	2.06	.....	.....	.....
29	1.85	2.52	2.90	3.70	3.35	2.50	1.86	.....	.....	.....
30	1.88	2.50	3.02	3.88	3.08	2.50	2.03	.....	1.55	.....
31	1.88	.....	3.00	.....	3.00	2.45	.....	.....	.....	.....
1908.										
1	.....	1.44	2.03	2.68	2.73	2.69	2.18	1.91	1.69	1.58
2	.....	1.46	2.23	2.71	2.75	2.65	2.21	1.88	1.64	1.64
3	.....	1.48	2.37	2.77	2.71	2.68	2.09	1.86	1.62	1.69
4	.....	1.54	2.27	2.94	2.74	2.58	2.05	1.79	1.63	1.59
5	.....	1.54	2.20	2.82	2.74	2.53	2.01	1.76	1.64	1.51
6	.....	1.59	2.09	2.75	2.67	2.54	2.14	1.73	1.66	1.44
7	.....	1.65	2.23	2.76	2.66	2.55	2.19	1.70	1.61	1.48
8	.....	1.62	2.40	2.74	2.69	2.54	2.10	1.69	1.61	1.46
9	1.49	1.65	2.48	2.83	2.66	2.49	2.90	1.68	1.64	1.45
10	1.54	1.76	2.31	2.91	2.66	2.43	2.21	1.67	1.60	1.51
11	1.50	1.88	2.23	3.05	2.64	2.55	2.12	1.67	1.94	1.53
12	1.47	1.97	2.22	3.14	2.73	2.58	2.12	1.66	1.97	1.53
13	1.53	2.09	2.20	3.17	2.88	2.56	2.17	1.64	1.93	1.48
14	1.57	2.16	2.15	3.14	2.82	2.48	2.20	1.62	1.96	1.47
15	1.63	2.26	2.18	3.23	2.75	2.48	2.22	1.61	1.91	1.44
16	1.62	2.29	2.36	3.26	2.74	2.43	2.18	1.60	1.80	1.48
17	1.65	2.24	2.49	3.29	2.68	2.39	2.14	1.61	1.74	1.49
18	1.69	2.26	2.46	3.10	2.64	2.49	2.10	1.68	1.70	.....
19	1.58	2.29	2.57	2.91	2.58	2.55	2.06	1.72	1.67	.....
20	1.48	2.22	2.69	2.89	2.53	2.56	2.04	1.71	1.66	.....
21	1.56	2.28	2.54	2.97	2.51	2.50	2.02	1.72	1.69	.....
22	1.56	2.39	2.54	3.06	2.49	2.51	2.02	1.77	1.68	.....
23	1.51	2.37	2.46	3.01	2.50	2.49	2.00	1.71	1.66	.....
24	1.55	2.17	2.64	3.01	2.50	2.47	1.97	1.78	1.65	.....
25	1.52	2.12	2.60	3.04	2.49	2.40	1.91	1.72	1.68	.....
26	1.54	2.02	2.48	2.97	2.51	2.37	1.91	1.67	1.69	.....
27	1.56	1.96	2.48	3.13	2.53	2.32	1.95	1.70	1.70	.....
28	1.52	1.95	2.37	2.92	2.52	2.23	1.96	1.73	1.71	.....
29	1.46	1.88	2.45	2.75	2.70	2.22	1.97	1.72	1.68	.....
30	1.54	1.90	2.54	2.75	2.66	2.22	1.95	1.69	1.65	.....
31	1.49	.....	2.57	.....	2.73	2.19	.....	1.70	.....	.....

NOTE.—Gage readings after September 1, 1907, were taken from a Friez automatic gage.
Probable ice conditions January 1 to March 17, 1907, November 1, 1907 to March 8, 1908, and December, 1908.

Rating table for Boulder Creek at Orodell, Colo., for 1907 to 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	10	2.10	57	2.70	171	3.30	377
1.60	13	2.20	70	2.80	200	3.40	420
1.70	18	2.30	85	2.90	230	3.50	465
1.80	26	2.40	103	3.00	263	3.60	510
1.90	35	2.50	123	3.10	299	3.70	555
2.00	45	2.60	145	3.20	337		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on daily gage heights and discharges furnished by the Central Colorado Power Company and is well defined.

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Daily discharge, in second-feet, of Boulder Creek at Orodell, Colo., February 4 to March 8, and December 18–31, 1908.

Day.	Feb.	Mar.	Dec.	Day.	Feb.	Mar.	Dec.
1		5.5		16	5.2		
2		7.0		17	5.2		
3		7.0		18	4.9		9.1
4		7.0		19	4.6		9.8
5	5.4	7.2		20	4.4		10.0
6	5.3	7.5		21	4.8		9.7
7	5.4	8.5		22	5.1		8.6
8	5.3	9.0		23	5.4		8.6
9	5.5			24	5.8		8.8
10	5.6			25	6.0		9.7
11	5.6			26	6.1		8.6
12	5.2			27	6.9		8.6
13	5.4			28	7.4		8.6
14	5.3			29	7.4		8.6
15	5.2			30			8.6
				31			8.6

NOTE.—These discharges were obtained from weir measurements. Records were also kept January 1 to February 4, but as the weir leaked, they have been discarded.

Monthly discharge of Boulder Creek at Orodell, Colo., for 1907 and 1908.

[Drainage area, 108 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1907.							
March 18–31	51	22	39.9	0.369	0.19	1,110	B.
April	127	30	70.4	.652	.73	4,190	A.
May	398	100	234	2.17	2.50	14,400	A.
June	636	263	467	4.32	4.82	27,800	A.
July	670	263	460	4.26	4.91	28,300	A.
August	263	94	164	1.52	1.75	10,100	A.
September	107	26	62.4	.578	.64	3,710	A.
October	57	24	32.0	.296	.33	1,970	A.
November	24	11	15.9	.147	.16	946	C.
December	11		7.83	.070	.08	481	C.
The period						93,000	
1908.							
January			4.5	.042	.05	277	C.
February			5.5	.051	.06	316	C.
March	17.4		10.4	.096	.11	640	B.
April	101	8.2	46.5	.431	.48	2,770	A.
May	167	49	103	.954	1.10	6,330	A.
June	373	165	252	2.33	2.60	15,000	A.
July	224	121	159	1.47	1.70	9,780	A.
August	167	69	119	1.10	1.27	7,320	A.
September	73	36	54.6	.506	.56	3,250	A.
October	36	13	19.6	.181	.21	1,210	A.
November	42	13	20.2	.187	.21	1,200	B.
December	17.4	8.6	9.87	.091	.10	607	C.
The year			67.0	.620	8.45	48,700	

NOTE.—Discharge estimated December 7, 1907, to February 4, 1908.

BOULDER CREEK NEAR BOULDER, COLO.

s station, which is located 1½ miles above the town of Boulder, l N., R. 71 W., was established May 13, 1895, to determine the ity of water available for irrigation and power development.

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Records were also kept on this stream near Boulder from 1888 to 1892. From 1895 to 1901 the station was maintained in cooperation with the state engineer of Colorado. From 1902 to 1906 the records are published only in the reports of the state engineer of Colorado.

The station is at the mouth of Boulder Canyon, about 1½ miles below Fourmile Creek and some 20 miles above the confluence with the St. Vrain.

Two small irrigation ditches take water above the station, but their combined flow amounts to only a few second-feet. The municipal supply of Boulder is also taken out above the station.

This valley is quite broad and is practically all under irrigation, the entire normal flow of the stream being used for that purpose.

The upper portions of this creek and its tributaries flow through mountainous areas which are extensively timbered, although they have been deforested to a very considerable extent. The drainage area above the Boulder station is 129 square miles, and at the junction with the St. Vrain, 434 square miles.

The Eastern Colorado Power Company is now constructing a plant on Boulder Creek which will have a capacity of probably 20,000 horsepower. By making use of storage facilities it would be possible to develop at least 50,000 horsepower on this stream during six months of the year. The upper waters are now being used for placer mining and by small power plants which aggregate less than 1,000 horsepower. Sites for additional power filings no doubt exist.

As good measurements can not be made during high water at the bridge where the gage is located, an auxiliary gage was located at the Ninth Street Bridge in Boulder, and high-water measurements have since been made at this point. Between the two gages the Farmers' canal and the Anderson ditch are diverted and Sand Creek and Gregory Creek come in, so allowance is made for these in using the measurements made at the Ninth Street Bridge to obtain the discharge at the upper gage.

Boulder Creek, like other mountain streams in this part of Colorado, is frozen over wholly or partly for three or four months in the winter time. The natural flow is not at present greatly modified by reservoirs, but will be when some of the reservoirs now under construction are completed.

The gage was washed out during the flood on August 1, 1908, and was replaced on August 14 by another gage in practically the same location, but the datum of which was about 0.5 foot lower than that of the old gage. No other changes in the gage datum are on record since the station was established.

As the stream is very swift and the bed is composed of bowlders it is impossible to procure very accurate results during high water. At moderate and low stages very good measurements can be obtained.

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Discharge measurements of Boulder Creek at Ninth Street Bridge, Boulder, Colo., in 1907 and 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	W. B. Freeman	56	83	2.60	452
June 7	C. L. Chatfield	57	97	2.65	497
June 27	....do	59	101	2.70	500
July 29	W. B. Freeman	55	85	2.50	495
August 30	....do	38	40	1.80	97
September 26[a]	Freeman and Stewart	30	20.6	1.18	16.5
October 23[a]	J. B. Stewart	32	25.4	1.30	29.1
1908.					
April 22[a]	C. L. Chatfield	38	36	1.66	60
April 23[a]	....do	38	41	1.72	72
May 14	W. B. Freeman	37	32	1.50	40
June 18[a]	J. B. Stewart	52.5	75	2.17	214
June 27	....do	55	79	2.28	270
June 29	C. L. Chatfield	48	56	2.00	154
July 31	....do	46.5	58	2.02	146

[a] Made by wading.

Discharge measurements of Boulder Creek at state engineer's gage near Boulder, Colo., in 1907 and 1908.

Date.	Hydrographer.	Gage height.	Discharge.
1907.		*Feet.*	*Sec.-ft.*
May 20	W. B. Freeman	2.42	452
June 7	C. L. Chatfield	2.40	501
June 27	....do	2.40	548
July 29	W. B. Freeman	2.13	527
August 30	....do	1.28	128
September 26	Freeman and Stewart	.40	34
October 23	J. B. Stewart	.47	31
1908.			
April 16[a]	Thomas Grieve, jr	.23	14.5
April 22[a]	....do	.98	83
Do	C. L. Chatfield	.98	70.4
April 23	....do	1.05	82.4
May 12[a]	Thomas Grieve, jr	.90	77
May 14	W. B. Freeman	.85	65
June 12[a]	Thomas Grieve, jr	1.80	284
June 18	J. B. Stewart	1.80	229
June 27	....do	1.90	303
June 29	C. L. Chatfield	1.52	182
July 15[a]	Thomas Grieve, jr	1.50	196
July 31	Stewart and Chatfield	1.55	184
August 14[a]	Thomas Grieve, jr	1.80	123
September 11[a]	....do	1.23	43
October 15[a]	....do	.78	19
November 21[a]	J. B. Stewart	.90	16.1
Do	....do	.90	17.5
December 8	C. L. Chatfield	[b]1.10	17.3
December 10	W. B. Freeman	.90	14

[a] Measured by wading at the gage. Other measurements have been computed from the measured discharge at the Ninth Street Bridge by adding the discharge of the two canals and deducting the inflow from Sand and Gregory creeks.

[b] Gage height affected by ice.

NOTE.—Measurements in 1907 were obtained by adding the total diversions between Ninth Street Bridge and this station to the measurements made at Ninth Street Bridge and subtracting the flow of Sand Creek. Measurements beginning August 14, 1908, are referred to a new gage at a different datum.

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Daily gage height, in feet, of Boulder Creek at state engineer's gage near Boulder, Colo., for 1907 and 1908.

[Alva Sparks, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1907.									
1	.....	1.50	2.02	2.75	1.98	1.05	0.58	0.52	0.55
2	.....	1.35	2.15	2.85	1.95	1.18	.58	.42	.62
3	.....	1.35	2.32	2.88	2.02	1.08	.48	.38	.65
4	.....	1.35	2.20	2.82	1.88	.98	.38	.32	.62
5	.....	1.38	2.35	2.82	1.82	1.02	.48	.32	.60
6	.....	1.28	2.42	2.80	1.68	1.02	.42	.35	.50
7	.....	1.35	2.40	2.72	1.62	.98	.42	.30	.50
8	.....	1.52	2.45	2.55	1.70	.90	.45	.25	.48
9	.....	1.65	2.30	2.55	1.68	.82	.52	.22	.45
10	.....	1.75	2.32	2.52	1.62	.82	.45	.32	.42
11	.....	1.80	2.32	2.42	1.52	.70	.38	.32	.38
12	.....	1.98	2.38	2.32	1.55	.72	.45	.45	.42
13	.....	1.98	2.42	2.35	1.55	.72	.45	.42	.45
14	.....	1.92	2.55	2.55	1.40	.80	.40	.52	.45
15	.....	1.90	2.52	2.50	1.58	.75	.48	.52	.32
16	.....	1.92	2.52	2.35	1.58	.70	.48	.42	.38
17	.....	2.02	2.58	2.10	1.40	.78	.48	.48	.35
18	.....	2.10	2.68	1.95	1.40	.72	.42	.55	.42
19	.....	2.28	2.58	2.05	1.42	.72	.38	.55	.32
20	.....	2.42	2.50	2.02	1.42	.75	.42	.55	.30
21	.....	2.42	2.42	2.02	1.38	.75	.45	.60	.25
22	.....	2.40	2.50	2.00	1.28	.75	.48	.58	.45
23	.....	2.40	2.52	2.18	1.08	.65	.50	.58	.62
24	.....	2.40	2.60	2.18	1.08	.68	.48	.55	.65
25	.....	2.32	2.68	2.38	1.08	.58	.38	.42	.62
26	.....	2.02	2.62	2.58	1.12	.55	.42	.52	.52
27	.....	1.85	2.65	2.45	1.18	.68	.42	.48	.52
28	.....	1.88	2.65	2.45	1.22	.72	.45	.58	.50
29	.....	1.85	2.58	2.32	1.28	.60	.42	.62	.48
30	.....	1.90	2.70	2.18	1.32	.52	.48	.50	.45
31	.....	1.85	.....	2.08	1.20	.....	.40	.....	.42
1908.									
1	0.05	.6	1.45	1.5	.....	1.4	1.05	.9	.....
2	.15	.8	1.5	1.55	.....	1.35	.9	.9	.....
3	.15	1.05	1.55	1.5	.....	1.3	.9	.8	.....
4	.1	.8	1.8	1.5	.....	1.2	1.0	.85	.....
5	.1	.85	1.6	1.55	.....	1.15	1.0	.85	.....
6	.2	.8	1.6	1.5	.....	1.2	.9	.9	.....
7	.2	.9	1.6	1.5	.....	1.3	.9	.85	.....
8	.2	1.1	1.55	1.5	.....	1.2	.9	.9	.....
9	.2	1.25	1.7	1.5	.....	1.15	.9	.9	.....
10	.25	1.0	1.75	1.45	.....	1.2	.9	.8	.....
11	.45	1.0	1.85	1.5	.....	1.2	.8	.8	.....
12	.55	.9	2.0	1.7	.....	1.2	.9	.8	.....
13	.65	.9	2.0	1.6	.....	1.3	.8	.8	.....
14	.75	.85	1.9	1.55	.....	1.3	.8	.8	.....
15	.85	.85	2.0	1.5	.....	1.4	.8	.9	.....
16	.9	1.1	2.0	1.5	1.8	1.35	.8	.95	.....
17	.85	1.2	2.05	1.4	1.8	1.3	.8	1.0	.....
18	.85	1.2	1.9	1.4	1.9	1.2	.8	.9	.....
19	.95	1.3	1.7	1.4	2.0	1.2	.8	.9	.....
20	.8	1.5	1.6	1.25	2.0	1.2	.8	.9	.....
21	.9	1.35	1.7	1.2	1.9	1.15	.75	.8	.....
22	1.05	1.3	1.75	1.2	2.0	1.2	1.0	.75	.....
23	1.05	1.2	1.65	1.2	1.9	1.2	.8	.8	.....
24	.8	1.45	1.7	1.2	1.8	1.15	.9	.75	.....
25	.75	1.45	1.8	1.2	1.8	1.2	.9	.9	.....
26	.65	1.3	1.7	1.25	1.7	1.2	.9	1.4	.....
27	.55	1.3	1.9	1.25	1.65	1.2	.95	.....	.....
28	.55	1.15	1.7	1.2	1.55	1.2	.8	.....	.....
29	.5	1.2	1.6	1.2	1.5	1.2	.9	.....	.....
30	.55	1.3	1.6	1.6	1.4	1.1	.9	.....	.....
31	.....	1.3	.....	1.55	1.4	.....	.9	.....	.....

NOTE.—The gage was more or less affected by ice conditions in the latter part of November and during December, 1907; also, after November 25, 1908. Gage was washed out during period August 1–15, 1908. Gage heights beginning August 16, 1908, refer to a new gage installed at a different datum. The new gage heights are not comparable with the old.

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Rating tables for Boulder Creek at state engineer's gage near Boulder, Colo.

MAY 1, 1907, TO JULY 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	5	0.80	58	1.60	206	2.40	550
.10	8	.90	70	1.70	238	2.50	606
.20	12	1.00	83	1.80	273	2.60	664
.30	18	1.10	97	1.90	312	2.70	725
.40	25	1.20	114	2.00	353	2.80	788
.50	32	1.30	133	2.10	398	2.90	853
.60	39	1.40	154	2.20	446	3.00	920
.70	48	1.50	178	2.30	497		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on seventeen discharge measurements made during 1907 and 1908, and is fairly well defined below gage height, 2.0 feet.

AUGUST 16 TO DECEMBER 31, 1908.

0.70	13	1.10	32	1.50	74	1.90	145
.80	15	1.20	40	1.60	89	2.00	170
.90	18	1.30	50	1.70	105		
1.00	24	1.40	61	1.80	123		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on five discharge measurements made during the above period, and is not well defined.

Monthly discharge of Boulder Creek at state engineer's gage near Boulder, Colo., for 1907 and 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
May	561	129	322	19,800	A.
June	725	362	589	35,000	B.
July	840	332	565	34,700	B.
August	362	94	186	11,400	A.
September	111	33	59.0	3,510	A.
October	38	24	28.5	1,750	B.
November 1–17	33	13	23.8	803	C.
The period				107,000	
1908.					
April	90	6	40.2	2,390	A.
May	178	39	103	6,330	A.
June	374	166	256	15,200	A.
July	238	114	161	9,900	A.
August 16–31		61	120	3,810	A.
September	61	32	43.3	2,580	B.
October	28	14	17.8	1,090	B.
November	24	14	17.0	1,010	C.
December			13.4	824	D.
The period				43,100	

NOTE.—Daily discharge estimated from November 26 to December 31, 1908.

KANSAS RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of Kansas River lies between the basins of and the Arkansas, entirely within the region of the Great he Kansas as such is a comparatively short stream, being the union of Smoky Hill and Republican rivers in Geary

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A. DIVERSION DAM, BELLE FOURCHE PROJECT, SOUTH DAKOTA.

B. DIVERSION DAM AND HEAD-GATES, BELLE FOURCHE PROJECT, SOUTH DAKOTA.

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County, Kans., whence it flows eastward, entering the Missouri at Kansas City, Mo.

The Smoky Hill rises near the boundary between Kansas and Colorado, pursues a winding but on the whole easterly course through Kansas, and near Junction unites with the Republican. Its length is 335 miles, and the extreme width of its basin is about 100 miles. The river runs close to the northern border of the Arkansas basin, and its chief tributaries are from the north. Solomon and Saline rivers are the most important, the former draining the northern part of Kansas and the latter the territory between the Solomon and the Smoky Hill.

Republican River rises in the arid plains of eastern Colorado, flows northeastward into southwestern Nebraska, then eastward through the southern tier of counties to Superior, where it turns to the southeast, enters Kansas, and finally joins the Smoky Hill. The length of the basin east and west is approximately 360 miles, its greatest width is 120 miles, and the total area drained is 25,840 square miles. The river is wide and rather shallow, with a rapid descent, and the bed is largely shifting quicksand of the most unstable character. In its upper course the Republican receives many tributaries, chiefly from the south. Nearly all of these flow through a region where the rainfall is less than 22 inches, but as this part of the basin is covered with buffalo grass, which sheds rain like a roof, the per cent of rainfall reaching the streams is great. Near the mouth the drainage area is very narrow and the tributaries are small and unimportant, but here the rainfall is 28 to 30 inches a year. Many small springs are found along the main stream and its branches, and the ground water generally lies at medium depth. The soil of the middle part of the basin is porous, sandy loam, and about 55 per cent of the land is under cultivation; along the lower course the soil is black loam and clay, and about 75 per cent of the land is cultivated. The rainfall in the lower basin is considered sufficient for all growing crops. The Republican is subject to sudden rises and falls, and occasionally overflows its banks.

The most important feeder of the Kansas below the junction of the Smoky Hill and Republican rivers is the Blue, which rises in southeastern Nebraska, flows to the southeast and south into Kansas, and joins Kansas River at Manhattan. The principal tributary of the Blue is the Little Blue, which rises in southern Nebraska, flows southeastward, and unites with the main stream near Blue Rapids.

The basin of the Kansas comprises the richest portion of the State of Kansas, consists of bottoms and rolling uplands, well timbered with oak, cottonwood, ash, elm, hickory, etc. The section is under a high state of cultivation and produces a great variety of crops. The river flows through a rich alluvial bottom land. The banks are

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Daily gage height, in feet, of Republican River at Bostwick, Nebr., for 1907 and 1908—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.										
11	1.45	1.2	1.15	2.5	1.85	2.2	1.1	1.1	1.5	2.7
12	1.45	1.2	1.65	3.6	2.05	2.45	1.0	1.0	1.45	2.85
13	1.45	1.15	1.25	3.5	2.85	1.45	1.0	.9	1.45	.....
14	1.4	1.1	2.55	.....	2.35	1.05	.95	.9	1.45	2.7
15	.....	1.1	1.8	2.05	2.15	.95	.9	.9	.....	2.55
16	1.4	1.1	1.3	3.6	2.15	1.85	.9	.85	1.45	2.4
17	1.35	1.15	1.2	3.9	1.45	1.95	.9	.85	1.55	1.85
18	1.35	1.15	1.2	6.3	1.95	1.3	.85	.....	1.55	1.75
19	1.35	.....	1.3	4.3	2.5	3.5	.85	.85	1.55	3.1
20	1.35	1.1	1.4	4.65	2.5	4.9	.....	.9	1.5	4.05
21	1.35	1.1	1.25	3.8	2.35	2.3	.7	.9	1.45	4.9
22	.....	1.1	1.15	2.9	2.05	4.4	.7	.9	1.55	4.8
23	1.35	1.1	1.1	3.4	3.6	3.6	.7	4.8	1.6	4.8
24	1.3	1.05	.....	3.5	2.95	2.9	.65	3.55	1.55	4.8
25	1.3	1.05	1.1	2.45	1.85	2.5	.65	.....	1.5	4.8
26	1.3	1.0	1.1	2.15	1.6	2.15	.65	2.6	1.5	4.75
27	1.3	1.0	1.1	2.2	2.5	2.2	.....	2.3	1.55	.....
28	1.3	1.0	1.85	1.85	2.0	1.85	.85	2.1	1.55	3.95
29	1.3	.95	1.35	1.65	1.7	2.3	.75	2.05	.....	3.9
30	1.3	.95	1.3	1.6	1.65	2.4	.75	1.9	1.65	3.85
31	1.3	.....	1.2	.....	1.5	2.0	.....	1.85	.....	3.8

NOTE.—Ice conditions about December 15, 1907, to February 29, 1908, and probably after December 6, 1908.

Rating tables for Republican River at Bostwick, Nebr.

APRIL 2 TO MAY 26, 1907.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	335	1.30	460	1.40	530	1.50	600
1.20	395						

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on one discharge measurement made during this period and the form of the preceding curve, and is fairly well defined.

MAY 27, 1907, TO MAY 15, 1908, AND SEPTEMBER 14 TO DECEMBER 31, 1908.

0.30	40	1.40	445	2.50	1,430	3.60	2,730
.40	50	1.50	520	2.60	1,540	3.70	2,860
.50	60	1.60	600	2.70	1,650	3.80	2,990
.60	75	1.70	680	2.80	1,760	3.90	3,120
.70	100	1.80	760	2.90	1,880	4.00	3,250
.80	130	1.90	850	3.00	2,000	4.20	3,510
.90	165	2.00	940	3.10	2,120	4.40	3,790
1.00	205	2.10	1,030	3.20	2,240	4.60	4,070
1.10	255	2.20	1,130	3.30	2,360	4.80	4,350
1.20	310	2.30	1,230	3.40	2,480	5.00	4,630
1.30	375	2.40	1,330	3.50	2,600		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the first period and three made during the last, and is fairly well defined between gage heights 0.5 foot and 2.5 feet.

MAY 16 TO JUNE 2, 1908, AND SEPTEMBER 1 TO SEPTEMBER 13, 1908.

[Daily discharges obtained by the indirect method for shifting channels.]

JUNE 3 TO AUGUST 31, 1908.

0.90	65	2.00	730	3.10	1,850	4.40	3,460
1.00	95	2.10	810	3.20	1,960	4.60	3,720
1.10	130	2.20	895	3.30	2,080	4.80	3,990
1.20	170	2.30	990	3.40	2,200	5.00	4,270
1.30	220	2.40	1,095	3.50	2,320	5.20	4,550
1.40	280	2.50	1,200	3.60	2,440	5.40	4,830
1.50	345	2.60	1,305	3.70	2,560	5.60	5,110
1.60	415	2.70	1,410	3.80	2,680	5.80	5,410
1.70	490	2.80	1,520	3.90	2,810	6.00	5,710
1.80	570	2.90	1,630	4.00	2,940	6.20	6,010
1.90	650	3.00	1,740	4.20	3,200	6.40	6,310

E.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four rge measurements made during this period and the form of the preceding curve, and is well defined en gage heights 2.0 feet and 3.7 feet.

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Daily discharge, in second-feet, of Republican River at Bostwick, Nebr., May 16 to June 2 and September 1 to September 13, 1908.

Day.	May.	June.	Sept.	Day.	May.	June.	Sept.	Day.	May.	June.	Sept.
1		200	560	11			210	21	320		
2		2,050	485	12			165	22	240		
3			420	13			165	23	215		
4			350	14				24	215		
5			440	15				25	215		
6			260	16	350			26	215		
7			235	17	290			27	215		
8			205	18	290			28	680		
9			205	19	350			29	320		
10			230	20	420			30	290		
								31	240		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Republican River at Bostwick, Nebr., for 1907 and 1908.

[Drainage area, 23,300 square miles.]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
April	565	460	518	30,800	C.
May	1,600	335	590	36,300	C.
June	2,120	375	699	41,600	B.
July	1,280	185	435	26,700	B.
August	205	75	123	7,560	D.
September	185	40	77.5	4,610	D.
October	310	68	122	7,500	D.
November	375	165	240	14,300	D.
December 1-14	375	310	345	9,580	C.
The period				179,000	
1908.					
March	720	375	460	28,300	C.
April	410	185	287	17,100	C.
May	1,480	185	337	20,700	C.
June	6,160	200	1,620	96,400	B.
July	2,440	280	812	49,900	B.
August	4,130	80	878	54,000	B.
September	560	88	203	12,100	D.
October	4,350	100	609	37,400	B.
November	805	482	546	32,500	B.
December			680	41,800	D.
The period				390,000	

NOTE.—Discharge estimated August 19–21 and November 24, 1907, and for days in 1908 for which gage heights are missing.

LITTLE BLUE RIVER NEAR FAIRBURY, NEBR.

This station, which is located at the highway bridge 1½ miles south of Fairbury and about 12 miles above the Nebraska-Kansas state line, was established May 23, 1908, to obtain data for use in studies of run-off and flood control and in power development.

Sandy Creek, the principal tributary, enters about 10 miles above. Muddy Creek, a small stream, is the only tributary between the station and the Kansas line.

The dam of the Fairbury Roller Mill is about 2 miles above the station, and may possibly cause some daily fluctuation in stage.

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Gage heights are apparently little affected by ice.

Records have been fairly satisfactory, though the channel shifts at high stages. The maximum discharges are somewhat uncertain as the river overflows its banks at about 11 feet gage height. The amount of overflow has been estimated.

Discharge measurements of Little Blue River near Fairbury, Nebr., in 1908.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 23	G. W. Bates	85	144	2.33	208
June 3	do	356	2,590	11.34	7,240
Do	Adna Dobson			12.52	[a] 10,100
June 20	Arthur Dobson	320	1,920	9.87	3,420
July 3	do	197	863	6.28	1,230
July 16	do	240	1,100	7.34	1,940
August 29	G. W. Bates	135	377	4.75	536
September 15	Arthur Dobson	120	118	3.20	218
October 2	do	70	105	2.90	189
November 19	do	70	100	2.90	175
December 12	do	70	99	2.97	194

[a] Estimated overflow was 1,760 second-feet.

Daily gage height, in feet, of Little Blue River near Fairbury, Nebr., for 1908.

[Fred F. Borland, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.25	5.1	4.35	4.2	2.9	2.9	2.85
2		9.95	4.8	4.1	4.0	2.85	2.9	2.8
3		11.9	6.4	3.9	3.8	2.85	2.9	2.75
4		10.3	5.0	3.75	3.75	2.85	2.85	3.05
5		12.3	4.6	4.9	3.7	2.9	2.9	3.0
6		13.9	6.6	3.45	3.45	2.9	2.9	2.95
7		13.9	8.1	3.3	3.4	2.95	2.9	2.9
8			6.1	3.5	3.5	3.0	2.85	2.85
9			7.45	3.45	3.35	3.0	2.85	2.9
10		12.5	5.9	3.4	3.35	2.8	2.85	2.95
11		8.3	5.1	3.5	3.25	2.9	2.8	3.0
12		9.4	4.75	3.5	3.2	2.85	2.8	3.6
13		11.4	9.25	3.9	3.2	2.85	2.8	3.8
14		10.2	11.7	4.7	3.2	2.85	2.8	2.9
15		9.8	11.15	4.2	3.2	2.85	2.8	2.9
16		7.8	7.65	3.8	3.25	2.85	2.85	2.9
17		11.5	5.4	4.4	3.1	2.85	2.9	2.9
18		7.6	4.7	3.75	3.1	2.85	2.9	2.9
19		12.6	4.55	4.95	3.05	2.9	2.9	2.9
20		10.2	4.3	11.8	3.05	2.9	2.9	2.9
21		8.6	8.5	12.9	3.0	2.9	2.9	2.9
22		7.0	4.9	10.6	2.95	2.9	2.9	2.9
23	2.3	7.0	8.6	9.8	2.9	2.95	2.9	2.85
24	2.3	9.5	8.9	6.4	2.9	2.9	2.9	2.85
25	2.3	8.35	9.2	5.9	2.85	2.9	2.9	2.85
26	2.5	7.75	6.8	5.3	3.05	2.9	2.9	2.8
27	2.3	7.1	5.9	5.5	3.0	2.9	2.9	2.85
28	8.05	11.4	5.55	5.15	2.9	2.9	2.9	2.85
29	11.1	6.9	4.8	4.75	2.9	2.9	3.0	2.45
30	6.05	5.4	4.4	4.5	2.9	2.9	3.0	2.65
31	4.9		4.5	4.25		2.9		2.75

Observer made no statement concerning possible ice conditions.

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Rating tables for Little Blue River near Fairbury, Nebr.

MAY 29 TO JUNE 10, 1908, AND JUNE 28 TO DECEMBER 31, 1908.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	130	3.90	330	5.40	810	7.80	2,300
2.50	140	4.00	350	5.50	850	8.00	2,480
2.60	150	4.10	375	5.60	890	8.20	2,660
2.70	160	4.20	400	5.70	940	8.40	2,840
2.80	170	4.30	425	5.80	990	8.60	3,030
2.90	180	4.40	450	5.90	1,040	8.80	3,230
3.00	190	4.50	480	6.00	1,090	9.00	3,430
3.10	200	4.60	510	6.20	1,190	10.00	4,600
3.20	210	4.70	540	6.40	1,310	11.00	6,520
3.30	225	4.80	575	6.60	1,430	12.00	8,800
3.40	240	4.90	610	6.80	1,560	13.00	11,340
3.50	255	5.00	650	7.00	1,700	14.00	13,980
3.60	270	5.10	690	7.20	1,840		
3.70	290	5.20	730	7.40	1,980		
3.80	310	5.30	770	7.60	2,140		

NOTE.—The above table is not applicable for ice or obstructed-channel conditions. It is based on eight discharge measurements made during the periods and one estimated measurement. It is well defined between gage heights 2.9 feet and 7.5 feet. Above gage height 7.5 feet it is fairly well defined.

MAY 23–28 AND JUNE 11–27, 1908.

[Daily discharges obtained by the indirect method for shifting channels.]

Daily discharge, in second-feet, of Little Blue River near Fairbury, Nebr., for 1908.

Day.	May.	June.	Day.	May.	June.	Day.	May.	June.
1			11		2,600	21		2,200
2			12		3,600	22		1,100
3			13		6,700	23	205	1,100
4			14		4,400	24	205	3,000
5			15		3,800	25	205	2,000
6			16		1,850	26	235	1,600
7			17		6,250	27	205	1,150
8			18		1,600	28	3,100	
9			19		8,300	29		
10			20		3,750	30		
						31		

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Blue River near Fairbury, Nebr., for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 23–31	6,730	205	1,400	25,000	D.
June	13,700	412	5,140	306,000	D.
July	8,080	425	1,770	109,000	A.
August	11,100	225	1,370	84,200	A.
September	400	175	225	13,400	A.
October	190	170	179	11,000	B.
November	190	170	178	10,600	B.
December	310	135	184	11,300	B.
The period				570,000	

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GASCONADE RIVER DRAINAGE BASIN.

DESCRIPTION.

The drainage basin of the Gasconade lies in the south-central part of Missouri. The river is formed by Piney, Lock, and Osage forks and Roubidoux Creek, which rise in southern Missouri and flow northward to unite in Laclede and Pulaski counties. From the junction of the forks to the point where the Gasconade enters the Missouri the distance by general course is about 60 miles, but including the windings it is probably more than 100 miles. The total area of the basin is about 3,500 square miles.

The headwater region comprises an area of regular outline, about 65 miles long by 45 miles wide, forming part of an elevated tableland belonging to the Ozark range of hills, and along the streams the surface is very rough and broken. The lower part of the basin, below Arlington, is long and narrow, its average width for a distance of about 55 miles being less than 15 miles. Below Vienna the valley averages about half a mile in width and is bordered by bluffs 100 to 200 feet high. Throughout the lower section the river flows in a succession of shoals and pools. On the shoals the stream bed is usually gravel, but the pools contain considerable deposits of sand and mud. Depth to rock beneath the stream bed is estimated at 10 to 30 feet. The rocks along the stream are chiefly limestone and sandstone.

The sources of the river are from 1,400 to 1,600 feet above sea level. At Arlington the elevation is about 650 feet and at the mouth of the river it is about 490 feet above the sea.

Above the junction of the forks the drainage basin is partly forested, but below that point it may be considered a deforested region. The mean annual rainfall is about 40 inches. The winters are mild. Facilities for storage have not been investigated.

The basin contains a great number of springs, some of those in the upper part being very large, and these springs help to maintain the low-season flow of the river. The streams offer fair opportunities for power development. As the main river is very crooked, it may be possible in some localities to shorten it by cutting across the narrow necks and to utilize the fall thus developed. Some of the tributaries may offer sites with good heads, as the slope of the tributaries is much greater than that of the main stream.

The Gasconade is subject to sudden floods, reaching approximately 25 feet above low water.

The following gaging stations have been maintained in this basin:

Gasconade River at Arlington, Mo., 1903 to 1906.
Piney Fork of Gasconade near Houston, Mo., 1908.
Piney Fork of Gasconade (also called Big Piney Creek) near Hooker, Mo., 1903.
Little Piney Creek near Arlington, Mo., 1903.

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PINEY FORK OF GASCONADE RIVER NEAR HOUSTON, MO.

This station, which is located about 3½ miles northwest of Houston, Mo., was established October 7, 1908, to obtain data for use in connection with water-power development.

Brushy Creek enters about 200 feet above the station. The low-water flow is modified by a power plant a short distance above the station. Measurements are made by means of a boat and cable or by wading in low water.

The datum of the chain gage, which is located 50 feet below the measuring section, has remained unchanged.

The following discharge measurement was made by wading October 7, 1908:

Width, 25.5 feet; area, 19 square feet; gage height, 4.87 feet; discharge, 19 second-feet.

Daily gage height, in feet, of Piney Fork of Gasconade River near Houston, Mo., for 1908.

[W. A. Stewart, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	.....	5.00	5.64	11	5.02	5.02	5.08	21	5.18	5.12	.....
2	.....	4.99	5.59	12	4.91	5.02	5.06	22	5.24	5.08	5.07
3	.....	5.01	5.35	13	4.90	5.01	.....	23	5.03	5.08	5.06
4	.....	5.04	5.32	14	4.84	.....	.....	24	5.04	5.08	5.06
5	.....	5.08	5.30	15	4.93	5.00	.....	25	4.82	5.08	5.05
6	4.89	.....	.....	16	4.94	4.92	5.04	26	5.00	5.09	.....
7	4.93	.....	5.25	17	4.92	4.98	5.02	27	4.86	5.14	5.08
8	4.88	5.01	5.24	18	4.91	4.99	5.05	28	5.15	5.30	.....
9	4.85	5.04	5.20	19	5.40	5.13	5.18	29	5.05	5.44	5.03
10	4.82	5.02	5.18	20	5.02	5.00	.....	30	5.04	5.62	5.06
								31	.....	.....	5.06

NOTE.—Probably no ice conditions in December.

MISCELLANEOUS MEASUREMENTS.

The miscellaneous measurements made in the Missouri River basin in 1907 and 1908 are presented in the following pages. They have been listed under drainage basins in the same order as the regular stations.

Miscellaneous measurements in Missouri River basin.

UPPER MISSOURI BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1908.				*Feet.*	*Sec.-ft.*
May 5	Springs	Dearborn River	Clemons, Mont.	.....	10
August 29	Antoin-Lapieve ditch.	Smith Creek, Sun River.	Nixon's ranch, near Augusta, Mont.	.....	6.5
August 31	Willow Creek	Teton River, Marias River.	Belleview, Mont.	.....	7.9

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Measurements of streams in Missouri River basin—Continued.

YELLOWSTONE RIVER BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec.-ft.*
[illegible]	Boulder River	Yellowstone River	Contact, Mont.		152
[illegible]	do	do	Mc Leod, Mont.		1,260
[illegible]	Pryor River	do	Pryor River, Wyo., at C. N. W. R. R.		a 1
[illegible]	do	do	do		a .5

BIG WIND RIVER BASIN.

[illegible]	Big Wind River	Bighorn River	Sweet Stagner's ranch, Wyo.	2.73	579
[illegible]	do	do	do	.80	370
[illegible]	[illegible] Creek	Big Wind River	Crowheart, Wyo.	1.20	a 35
[illegible]	Dry Creek	do	Above head of Dry Creek ditch, near Crowheart, Wyo.		b 24.2
[illegible]	do	do	Crowheart, Wyo.		23.4
[illegible]	do	do	do	3.10	a 12
[illegible]	Meadow Creek	do	J. K. Ranch, Wyo.		13.5
[illegible]	do	do	do	2.00	10
[illegible]	Willow Creek	do	do		15.6
[illegible]	do	do	do	1.50	a 12
[illegible]	Beaver Lake Creek	do	do	1.37	119
[illegible]	do	do	do	.95	40
[illegible] 24	Wyoming Central Irrigation Co. canal	do	Riverton, Wyo.		a 30
[illegible] 1	Beaver Creek	Little Wind River	10 miles north of Fort Washakie, Wyo.		a 8
[illegible] 31	Trout Creek	do	Wind River, Wyo.		a 12
[illegible] 22	do	do	do	2.40	9.6
[illegible]	Wyoming Central Irrigation Co. canal	Big Wind River	Riverton, Wyo.		a 10
[illegible] 7	Popo Agie River	Little Wind River	Above sinks 10 miles above Lander, Wyo.		45
Do	do	do	Below sinks 10 miles above Lander, Wyo.		60
1907.					
[illegible]	Popo Agie River	Little Wind River	Hudson, Wyo.	c—13.20	389
[illegible]	do	do	do	c—13.70	142
1908.					
[illegible]	Popo Agie River	Little Wind River	Hudson, Wyo.	c—11.45	2,090
[illegible]	do	do	do	c—13.28	451
[illegible]	do	do	do	c—13.30	401
[illegible] 25	do	do	do	c—13.54	
[illegible] 5	do	do	do		
1907.					
October 21	Popo Agie River	Little Wind River	Arapahoe, Wyo.		151
1908.					
[illegible] 6	Popo Agie River	Little Wind River	Arapahoe, Wyo.		204
June 14	Baldwin Creek	Popo Agie River	Lander, Wyo.		82
October 20	do	do	do		a 8
June 14	Squaw Creek	do	do		a 5
October 20	do	do	do		a 3
Do	North Fork of Popo Agie River.	do	Milford, Wyo.		a 50
August 24	do	do	Lander, Wyo.	d—4.85	164
Do	do	do	do	d—4.85	169
June 14	Little Popo Agie River.	do	5 miles above Hudson, Wyo.		395
April 20	North Fork of Shoshone River.	Shoshone River	Marquette, Wyo.		1,620

a Estimated.
b Flood measurement.
c Distance down from reference mark on W. N. W. R. R. bridge near Hudson just below mouth of Little Popo Agie. This reference mark is black cross, painted on NE. corner of cast-iron shoe at foot of first tier of tension rods from right abutment, downstream side of bridge.
d Distance down from reference mark, which is nail driven into stringer on downstream side of bridge, 7 feet from left abutment. This bridge is 3½ miles north of Lander.

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Miscellaneous measurements in Missouri River basin—Continued.

HEART RIVER BASIN.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1907.					
July 21	Heart River	Missouri River	Mandan, N. Dak.		205
July 25	do	do	do		534
1908.					
August 8	Heart River	Missouri River	"Big Bend" sec. 29, T. 136 N., R. 84 W., N. Dak.		17.1
August 9	do	do	Mandan, N. Dak.		25.9
August 5	Little Heart River	do	Little Heart, sec. 15, T. 137 N., R. 81 W., N. Dak.		.16

CANNON BALL RIVER BASIN.

1908.					
August 17	North Fork of Cannon Ball River.	Cannon Ball River	New England, N. Dak.		0.3
May 8	do	do	Mott, N. Dak.		6.55
August 5	Dogtooth Creek	do	Bridge, north of Stevenson, N. Dak.		.40

WHITE RIVER.

1908.					
July 19	White River	Missouri River	Sec. 35, T. 34 N., R. 48 W., Nebraska.		14.0
July 8	do	do	Sec. 7, T. 34 N., R. 47 W., Nebraska.		99.1
June 10	Ash Creek	White River	Sec. 12, T. 32 N., R. 51 W., Nebraska.		15.0
June 14	do	do	do		47.8
June 15	Dead Horse Creek	do	Sec. 32, T. 32 N., R. 49 W., Nebraska.		2.70
June 14	Indian Creek	do	Sec. 28, T. 32 N., R. 50 W., Nebraska.		1.46
Do	East Fork of Indian Creek.	Indian Creek	do		1.22
Do	West Fork of Indian Creek.	do	do		.42
June 19	Chadron Creek	White River	Sec. 12, T. 32 N., R. 49 W., Nebraska.		3.79
June 30	Big Bordeaux Creek	do	Sec. 11, T. 32 N., R. 48 W., Nebraska.		.19
July 25	do	do	Sec. 23, T. 33 N., R. 48 W., Nebraska.		5.97
July 17	do	do	Sec. 21, T. 34 N., R. 48 W., Nebraska.		6.77
June 26	Little Bordeaux Creek	Big Bordeaux Creek	Sec. 29, T. 33 N., R. 47 W., Nebraska.		2.17
July 3	Beaver Creek	White River	Sec. 4, T. 33 N., R. 46 W., Nebraska.		1.65
July 8	do	do	Sec. 34, T. 35 N., R. 47 W., Nebraska.		1.45

NIOBRARA RIVER BASIN.

1908.					
May 16	Eagle Creek	Niobrara River	¼ mile above mouth, sec. 1, T. 32 N., R. 11 W., Nebr.		64
Do	Red Bird Creek	do	½ mile above mouth, sec. 11, T. 32 N., R. 10 W., Nebr.		45
September 9	Verdigris Creek	do	Verdigris, Nebr.		56
May 17	do	do	Niobrara, Nebr.		138

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Miscellaneous measurements in Missouri River basin—Continued.

MINOR MISSOURI RIVER DRAINAGE, IN NEBRASKA.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1908.					
May 16	Ponca Creek	Missouri River	Lynch, Nebr.		201
September 9	do	do	do		10
Do	do	do	Spencer, Nebr.		6.5
September 10	Bazile Creek	do	Creighton, Nebr.		6.3
May 16	do	do	Niobrara, Nebr.		97
May 11	Weeping Water Creek	do	Nehawka, Nebr.		38

NORTH PLATTE.

1908.					
November 20	North Platte	Platte River	Bridgeport, Nebr.		1,070
October 29	Casper Creek	North Platte	Casper, Wyo.		0
Do	Big Muddy Creek	do	Big Muddy, Wyo.		a 1
Do	Deer Creek	do	Glenrock, Wyo.		a 10
Do	Box Elder Creek	do	Careyhurst, Wyo		a 8
November 8	La Prele Creek	do	Fetterman, Wyo.		a 6
October 29	do	do	Douglas, Wyo.		a 3
Do	Chugwater Creek	Laramie River	Diamond, Wyo.		a 5
1907.					
October 18	Chugwater Creek	Laramie River	Chugwater, Wyo.		a 15

PLATTE RIVER BASIN.

1908.					
April 20	Platte River	Missouri River	Fremont, Nebr.		4,540
September 11	North Fork of Elkhorn River.	Elkhorn River	Pierce, Nebr.		46
Do	do	do	Norfolk, Nebr.		85
October 16	Oak Creek	Salt Creek	West line of sec. 16, T. 10 N., R. 6 E., Nebr.		51.3
November 24	do	do	North line of sec. 17, T. 10 N., R. 6 E., Nebr.		72
1907.					
May 16	Wahoo Creek	Salt Creek	Ashland, Nebr.		64
Do	do	do	do		72

SOUTH PLATTE.

1908.					
June 10	South Platte River	Platte River	Fort Morgan, Colo.		a 8
Do	do	do	Union, Colo.	0.70	90
July 21	do	do	do	.90	155
1907.					
April 4	South Platte River	Platte River	North Platte, Nebr.		0
July 16	do	do	do		a 200
1908.					
June 2	South Platte River	Platte River	North Platte, Nebr.		95
September 16	do	do	do		0
Do	North Fork of South Platte River.	South Platte River	Above mouth of Geneva Creek at Grant, Colo.		38
July 5	do	do	do		33
September 5	do	do	do		13
October 27	do	do	do		15.6
December 15	do	do	do		5.1
December 17	do	do	South Platte, Colo.		40
June. 7	Geneva Creek	North Fork of South Platte River.	Geneva Park, Colo.		52
July 5	do	do	do		42
"	do	do	Grant, Colo.		66
"	do	do	do		26.5
"	do	do	do		13.5
"	do	do	Geneva Park, Colo.		3.7
"	Duck Lake Creek	Geneva Creek	do		a 2
"	do	do	do		

a Estimated.

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Miscellaneous measurements in Missouri River basin—Continued.

SOUTH PLATTE—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1908.					
June 7	Scott-Gomer Creek	Geneva Creek	Grant, Colo.		[a] 16
December 29	do	do	do		[a] 4
June 7	Threemile Creek	do	do		[a] 3
December 29	do	do	do		[a] 1
1907.					
February 14	Plum Creek	South Platte River	Sedalia, Colo.		[a] 3
March 10	do	do	do		[a] 10
March 28	do	do	do		[a] 1
March 20	do	do	Toluca, Colo.		[a] 5
August 27	Bear Creek	do	Morrison, Colo.		[b] 4,000
October 24	do	do	do		9.6
February 17	Cherry Creek	do	Denver, Colo.		[a] 3
September 5	do	do	do		[b] 2,600
1908.					
June 17	Cherry Creek	South Platte River	Denver, Colo.		47
1907.					
March 15	North Fork of Clear Creek.	Clear Creek	Forkscreek, Colo.		[a] 4
March 16	do	do	do		4.7
April 11	do	do	do		16
April 23	do	do	do		23
May 10	do	do	do		46
August 9	do	do	do		[a] 25
October 11	do	do	do		7
December 5	do	do	do		6
1908.					
February 20	North Fork of Clear Creek.	Clear Creek	Forkscreek, Colo.		4.7
March 16	do	do	do		[a] 5
May 21	do	do	do		17
June 17	do	do	do		20
August 15	do	do	do		6.3
October 30	do	do	do		5.4
December 11	do	do	do		2.8
1907.					
April 23	South Fork of Clear Creek.	Clear Creek	Forkscreek, Colo.		92
1908.					
December 4	Clear Creek	South Platte	Golden, Colo.	[c] 0.43	64
December 12	do	do	do	[c] 0.02	37
Do	do	do	do	[c] 0.02	36
December 28	do	do	do	[c] 1.42	65
1907.					
March 5	St. Vrain Creek	South Platte	Longmont, Colo.		[a] 30
Do	Boulder Creek	St. Vrain Creek	Boulder, Colo.		[a] 5
1908.					
September 3	South Fork of Middle Boulder Creek.	Boulder Creek	Above mouth of Jasper Creek.		6.8
Do	do	do	Below Jasper Creek reservoir site.		15.1
Do	North Fork of Middle Boulder.	do	Hessie, Colo.		[d] 12.4
September 2	Selfridge and Mann power plant intake.	Middle Boulder	Sec. 35, T. 1 N., R. 72 W., Colo.		1.1
September 4	North Boulder Creek	Boulder Creek	Boulder Co. ranch		20.4
Do	Fourmile Creek	do	Sunshine, Colo.		[a] 1.5
1907.					
March 13	Fourmile Creek	Boulder Creek	Boulder, Colo.		[a] 3
March 19	do	do	do		[a] 5
April 12	do	do	do		8.3
April 22	do	do	do		13

[a] Estimated.
[b] Kutters formula estimate.
[c] Measurements taken at Denver Reservoir Irrigation Company's gage, and all but second one on December 12 were taken by the company's hydrographers.
[d] Float measurement.

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Miscellaneous measurements in Missouri River basin—Continued.

SOUTH PLATTE—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
				Feet.	*Sec. ft.*
1908.					
September 4	South Boulder Creek	Boulder Creek	Tolland, Colo	1.90	14.5
1907.					
March 5	South Boulder Creek	Boulder Creek	Marshall, Colo		a 12
March 13	do	do	do		a 7
March 18	do	do	do		a 15
April 12	do	do	do		a 20
1908.					
September 4	Perigo Ditch	South Boulder Creek	Rollinsville, Colo		b 2.8
September 3	Jenny Creek	do	Above head of Black Hills Ditch, Colo.		4.2
Do	Black Hills Ditch	Jenny Creek	Tolland, Colo		4.2
September 5	Left Hand Creek	St. Vrain Creek	Below mouth of California Gulch, near Ward, Colo.		a 4
Do	do	do	Goldhill, Colo		a 12
October 29	Crow Creek	South Platte River	Fort Russell, Wyo		a 15

KANSAS RIVER BASIN.

1908.					
September 17	Blue River	Kansas River	Millrace, Crete, Nebr		300
September 16	do	do	Wilber, Nebr		288
January 18	do	do	Beatrice, Nebr		292
February 29	do	do	do		705
March 27	do	do	do		347
April 25	do	do	do	2.15	305
May 19	do	do	do	2.25	383
June 5	do	do	do	15.10	12,200
June 23	do	do	do	7.20	3,700
July 25	do	do	do	3.61	990
September 16	do	do	do	2.42	307
October 23	do	do	do	2.52	470
November 28	do	do	do		378
December 30	do	do	do	2.38	370

a Estimated. b Float measurement.

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INDEX.

A.

Page.

Accuracy, degree of..... 27-28
Acknowledgments to those aiding..... 29
Acre-foot, definition of..... 13
Agency ditch near—
  Harlem, Mont.:
    description..... 133
    discharge..... 133
    gage heights..... 134
American Fork near—
  Harlowton, Mont.:
    description..... 100
    discharge..... 100
    discharge, monthly..... 102
    gage heights..... 101
    rating tables..... 102
Antoin-Lapieve ditch near—
  Augusta, Mont.:
    discharge..... 291
Appropriations, amount of..... 7
Arapahoe, Wyo.,
  Little Wind River above:
    description..... 186
    discharge..... 186
    discharge, monthly..... 188
    gage heights..... 187
    rating tables..... 188
  Little Wind River below:
    description..... 189
    discharge..... 189
    discharge, monthly..... 191
    gage heights..... 190
    rating tables..... 191
  Popo Agie River at:
    discharge..... 292
Ash Creek:
  discharge..... 293
Ashfield, Mont.,
  Beaver Creek near:
    description..... 123-124
    discharge..... 124
Ashland, Nebr.,
  Wahoo Creek at:
    discharge..... 294
Augusta, Mont.,
  Antoin-Lapieve ditch near:
    discharge..... 291
  Ford Creek near:
    description..... 66
    discharge..... 66
    discharge, monthly..... 68-69
    gage heights..... 67
    rating tables..... 68
  Smith Creek near:
    description..... 69
    discharge..... 69
    discharge, monthly..... 72
Augusta, Mont.—Continued.
  Smith Creek near—Continued. Page.
    discharge curves, chart..... 23
    gage heights..... 70
    rating tables..... 71
  Sun River (North Fork) near:
    description..... 53
    discharge..... 54
    discharge, monthly..... 56
    gage heights..... 54-55
    rating tables..... 55
  Sun River (South Fork) at:
    description..... 60
    discharge..... 60
    discharge, monthly..... 62-63
    gage heights..... 61
    rating tables..... 62
  Willow Creek near:
    description..... 63
    discharge..... 63
    discharge, monthly..... 65-66
    gage heights..... 64
    rating tables..... 65
Authority for investigations, recital of..... 7

B.

Badger Creek near—
  Family, Mont.:
    description..... 82
    discharge..... 82
    discharge, monthly..... 84
    gage heights..... 82-83
    rating tables..... 83-84
Baldwin Creek at—
  Lander, Wyo.:
    discharge..... 292
Barratts, Mont.,
  Beaverhead River at:
    description..... 34-35
    discharge..... 35
    discharge, monthly..... 37
    gage heights..... 35-36
    rating tables..... 36
Bates, G. W., work of..... 30
Bazile Creek at—
  Creighton, Nebr.:
    discharge..... 294
  Niobrara, Nebr.:
    discharge..... 294
Bear Creek at—
  Morrison, Colo.:
    discharge..... 295
Beatrice, Nebr.,
  Blue River at—
    discharge..... 296
Beaver Creek (of Milk River) near—
  Ashfield, Mont.:
    description..... 123-124
    discharge..... 124

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Beaver Creek overflow (of Milk River) near—
Bowdoin, Mont.: Page.
description 124
gage heights 124
Beaver Creek (of White River):
discharge 293
Beaverhead River at—
Barratts, Mont.:
description 34–35
discharge 35
discharge, monthly 37
gage heights 35–36
rating tables 36
Dillon, Mont.:
description 37
discharge 37
gage heights 38
Belle Fourche project, views at 282
Belleville, Mont.,
Teton River near:
description 89–90
discharge 90
discharge, monthly 91
gage heights 90
rating table 90
Willow Creek at:
discharge 291
Big Bend, N. Dak.,
Heart River at:
discharge 293
Big Bordeaux Creek:
discharge 293
Bighorn River near—
Hardin, Mont.:
description 182–183
discharge 183
discharge, monthly 185
gage heights 183–184
rating tables 184–185
Bighorn River basin:
description 178–180
miscellaneous measurements 292
stream flow 180–201
Big Muddy Creek at—
Big Muddy, Wyo.:
discharge 294
Big Muddy River basin:
stream flow 141
Big Muddy River near—
Culbertson, Mont.:
description 141
discharge 141
gage heights 141
Big Timber Creek (North Fork) near—
Big Timber, Mont.:
description 151
discharge 151
discharge, monthly 153
gage heights 151–152
rating tables 152–153
Big Timber Creek (South Fork) near—
Big Timber, Mont.:
description 153
[illegible]ischarge 154
[illegible]ischarge, monthly 155
[illegible]age heights 154–155
[illegible]ating tables 155
Big Wind River at or near—
Riverton, Wyo.: Page.
description 180
discharge 181
discharge, monthly 182
gage heights 181
rating tables 182
Stagner's ranch, Wyo.:
discharge 292
Birch Creek near—
Dupuyer, Mont.:
description 85
discharge 85
discharge, monthly 87
gage heights 85–86
rating tables 86
Black Hills ditch at—
Tolland, Colo.:
discharge 296
Black Hills ditch mouth, Colo.,
Jenny Creek near:
discharge 296
Blue River at—
Beatrice, Nebr.:
discharge 296
Crete, Nebr.:
discharge 296
Wilber, Nebr.:
discharge 296
Bostwick, Nebr.,
Republican River at:
description 284
discharge 285
discharge, daily 287
discharge, monthly 287
gage heights 255–286
rating tables 286
Boulder, Colo.,
Fourmile Creek at:
discharge 295
Boulder Co. ranch,
North Boulder Creek at:
discharge 295
Boulder Creek at or near—
Boulder, Colo.:
description 278–279
discharge 280, 295
discharge, monthly 282
gage heights 281
rating tables 282
Contact, Mont.:
discharge 292
McLeod, Mont.:
discharge 292
Orodell, Colo.:
description 275
discharge 276
discharge, daily 278
discharge, monthly 278
gage heights 276–277
rating table 277
Boulder River (East Fork) near—
McLeod, Mont.:
description 156
discharge 156
discharge, monthly 158
gage heights 156–157
rating tables 157

Digitized by Google

Boulder River (West Fork) at or near—
Bruffeys, Mont.: Page.
description 158
discharge 159
discharge, monthly 162
gage heights 159–161
rating table 162
McLeod, Mont.:
description 163
discharge 163
discharge, monthly 165
gage heights 163–164
rating tables 164–165
Bowdoin, Mont.,
Beaver Creek overflow near:
description 124
gage heights 124
Box Elder Creek at—
Careyhurst, Wyo.:
discharge 294
Bridgeport, Nebr.,
North Platte River at:
discharge 294
Broncho, N. Dak.,
Knife River at:
description 210
discharge 210
discharge, daily 212
discharge, monthly 213
gage heights 211
rating tables 212
Browning, Mont.,
Milk River (South Fork) near:
description 106
discharge 106
discharge, monthly 108
gage heights 107
rating tables 108
Bruffeys, Mont.,
Boulder River (West Fork) near:
description 158
discharge 159
discharge, monthly 162
gage heights 159–161
rating table 162
Bull Lake Creek at—
J. K. ranch, Wyo.:
discharge 292

C.

Cache la Poudre River, reservoir site on, view of 250
Cannon Ball River at—
Stevenson, N. Dak.:
description 217–218
discharge 218
discharge, monthly 220
gage heights 218–219
rating table 219
Cannon Ball River basin:
description 217
gaging station 217
miscellaneous measurements 293
stream flow 217–220
Cannon Ball River (North Fork) at—
Mott, N. Dak.:
discharge 293
Cannon Ball River (North Fork) at—Con.
New England, N. Dak.: Page.
discharge 293
Careyhurst, Wyo.:
Box Elder Creek at—
discharge 294
Cascade, Mont.:
Missouri River at—
description 38
discharge 38
discharge, monthly 41
gage heights 39
rating tables 40
Casper Creek at—
Casper, Wyo.:
discharge 294
Cassels, Colo.,
South Platte River (North Fork) at:
description 268
discharge 268, 294
discharge, monthly 269
gage heights 268
rating table 269
Chadron Creek:
discharge 293
Chandler, E. F., work of 29
Chatfield, C. L., work of 29
Cherry Creek at—
Denver, Colo.:
discharge 295
Chinook, Mont.,
Cook canal near:
description 129
discharge 130
discharge, monthly 131
gage heights 130
Fort Belknap canal near:
description 134
discharge 135
discharge, monthly 136
gage heights 135
description 131
discharge 131
discharge, monthly 132
gage heights 131
Milk River (North Fork) near:
description 120
discharge 120–121
discharge, daily 123
discharge, monthly 123
gage heights 121–122
rating table 122
Milk River (West Fork) at:
description 117–118
discharge 118
discharge, daily 119
discharge, monthly 120
gage heights 119
Paradise Valley Canal near:
description 128
discharge 128
discharge, monthly 129
gage heights 129
Winter-Anderson canal near:
description 136
discharge 136
discharge, monthly 137
gage heights 136

Digitized by Google

Chugwater Creek at—
Chugwater, Wyo.: Page.
discharge.... 294
Diamond, Wyo.:
discharge.... 294
Clancy, Mont.—
Lump Gulch Creek near:
description.... 45
discharge.... 45
gage heights.... 46
Prickly Pear Creek at:
description.... 43
discharge.... 43
gage heights.... 44
Clark Fork at—
Fromberg, Mont.:
description.... 172
discharge.... 173
discharge, monthly.... 175
gage heights.... 173–174
rating tables.... 174
Clear Creek at or near—
Forkscreek, Colo.:
description.... 271–272
discharge.... 272
discharge, daily.... 274
discharge, monthly.... 275
gage heights.... 273
rating tables.... 274
Golden, Colo.:
discharge.... 272, 295
Clear Creek (North Fork) at—
Forkscreek, Colo.:
discharge.... 295
Clear Creek (South Fork) at—
Forkscreek, Colo.:
discharge.... 295
Clemons, Mont.,
Dearborn River near:
description.... 48
discharge.... 49
gage heights.... 49
Falls Creek near:
description.... 49–50
discharge.... 50
gage heights.... 50
springs at:
discharge.... 291
Cody, Wyo.,
Shoshone River at:
description.... 194
discharge.... 194
discharge, monthly.... 197
gage heights.... 195
rating tables.... 196
Colorado, cooperation of.... 29
Columbus, Nebr.,
Loup River at:
description.... 245
discharge.... 246
gage heights.... 246–247
Platte River at:
description.... 242
discharge.... 242
discharge, monthly.... 245
gage heights.... 243
rating tables.... 244
Contact, Mont.,
Boulder Creek at: Page.
discharge.... 292
Continental divide, view of.... 250
Cook canal near—
Chinook, Mont.:
description.... 129
discharge.... 130
discharge, monthly.... 131
gage heights.... 130
Cooperation, credit for.... 29
Corbett dam, Wyo.,
Shoshone River at:
description.... 197
discharge, monthly.... 198
gage heights.... 198
rating table.... 198
view.... 196
Creighton, Nebr.,
Bazile Creek at:
discharge.... 294
Crete, Nebr.,
Blue River at:
discharge.... 296
Crow Creek at—
Fort Russell, Wyo.:
discharge.... 296
Crowheart, Wyo.,
Dinwoodie Creek at:
discharge.... 292
Dry Creek at and near:
discharge.... 292
Culbertson, Mont.,
Big Muddy River near:
description.... 141
discharge.... 141
gage heights.... 141
Current meter, description of.... 19–20
use of.... 18, 20–21
views of.... 20
Current-meter stations, views of.... 18, 20
Curves, discharge, figures showing.... 23, 24
Cutbank Creek at—
Cutbank, Mont.:
description.... 73
discharge.... 74
discharge, daily.... 76
discharge, monthly.... 76
gage heights.... 74–75
rating tables.... 75

D.

Dead Horse Creek:
discharge.... 293
Dearborn River basin:
description.... 48
gaging stations.... 48
stream flow.... 48–50
Dearborn River near—
Clemons, Mont.:
description.... 48
discharge.... 49
gage heights.... 49
Deer Creek at—
Glenrock, Wyo.:
discharge.... 294
Definitions, statements of.... 13

Digitized by Google

Denver, Colo.,
Cherry Creek at: Page.
discharge..... 295
Diamond, Wyo.,
Chugwater Creek at:
discharge..... 294
Dillon, Mont.,
Beaverhead River at:
description..... 37
discharge..... 37
gage heights..... 38
Dinwoodie Creek at—
Crowheart, Wyo.:
discharge..... 292
Discharge, computation of..... 21-27
curves for, figure showing..... 23, 24
Discharge measurements, nature of..... 15, 16
Dobson, Adna, work of..... 30
Dobson, A. A., work of..... 30
Dogtooth Creek near—
Stevenson, N. Dak.:
discharge..... 293
Douglas, Wyo.,
La Prele Creek at:
discharge..... 294
Drainage, stream flow and..... 9-10
Drainage basins, list of..... 10
Dry Creek at and near—
Crowheart, Wyo.:
discharge..... 292
Duck Lake Creek at—
Geneva Park, Colo.:
discharge..... 294
Dupuyer, Mont.,
Birch Creek near:
description..... 85
discharge..... 85
discharge, monthly..... 87
gage heights..... 85-86
rating tables..... 86
Dupuyer Creek at:
description..... 87
discharge..... 87
discharge, monthly..... 89
gage heights..... 88
rating tables..... 88

E.

Eagle Creek:
discharge..... 293
East Helena, Mont.,
Prickly Pear Creek near:
description..... 44
discharge..... 44
gage heights..... 45
Elkhorn reservoir site, view of..... 250
Elkhorn River (North Fork) at—
Norfolk, Nebr.:
discharge..... 294
Pierce, Nebr.:
discharge..... 294
Equivalents, list of..... 14-15

F.

Fairbury, Nebr.,
Little Blue River near:
description..... 287-288
discharge..... 288
discharge, daily..... 289
Fairbury, Nebr.—Continued.
Little Blue River near—Continued. Page.
discharge, monthly..... 289
gage heights..... 288
rating tables..... 289
Falls Creek near—
Clemons, Mont.:
description..... 49-50
discharge..... 50
gage heights..... 50
Family, Mont.,
Badger Creek near:
description..... 82
discharge..... 82
discharge, monthly..... 84
gage heights..... 82-83
rating tables..... 83-84
Two Medicine River at:
description..... 79
discharge..... 79
discharge, monthly..... 81
gage heights..... 79-80
rating tables..... 80-81
Fetterman, Wyo.,
La Prele Creek at:
discharge..... 294
Field practice, methods of..... 16-21
Firehole River, cascade on, view of..... 30
Float method, description of..... 19
Flood prevention, stream flow and..... 10
Follansbee, Robert, work in charge..... 29, 30
Ford Creek near—
Augusta, Mont.:
description..... 66
discharge..... 66
discharge, monthly..... 68-69
gage heights..... 67
rating table..... 68
Forest service, cooperation of..... 29
Forkscreek, Colo.,
Clear Creek at:
description..... 271-272
discharge..... 272
discharge, daily..... 274
discharge, monthly..... 275
gage heights..... 273
rating tables..... 274
Clear Creek (North Fork) at:
discharge..... 295
Clear Creek (South Fork) at:
discharge..... 295
Fort Belknap canal near—
Chinook, Mont.,
description..... 134
discharge..... 135
discharge, monthly..... 136
gage heights..... 135
Fort Morgan, Colo.,
South Platte River at:
discharge..... 294
Fort Russell, Colo.,
Crow Creek at:
discharge..... 296
Fort Washakie, Wyo.,
Little Wind River at:
description..... 185
discharge..... 186
gage heights..... 186

Digitized by Google

Fort Washakie, Wyo.—Continued.
Sage Creek near: Page.
discharge 292
Fourmile Creek at—
Boulder, Colo.:
discharge 295
Sunshine, Colo.:
discharge 295
Frazer, Mont.,
Little Porcupine Creek near:
description 138
discharge 138
gage heights 138
Freeman, W. B., work in charge of 29, 30
Fremont, Nebr.,
Platte River at:
discharge 294
Fromberg, Mont.,
Clark Fork at:
description 172
discharge 173
discharge, monthly 175
gage heights 173–174
rating tables 174

G.

Gage heights, nature of 15
Gaging stations, classification of 22–27
description of 18
Gasconade River basin:
description 290
gaging stations 290
stream flow 291
Gasconade River (Piney Fork) near—
Houston, Mo.:
description 291
discharge 291
gage heights 291
Geneva Creek at or near—
Geneva Park, Colo.:
discharge 294
Grant, Colo.:
description 269–270
discharge 270, 294
discharge, monthly 271
gage heights 270
rating table 270
Geneva Park, Colo.,
Duck Lake Creek at:
discharge 294
Geneva Creek at:
discharge 294
Glendive, Mont.,
Yellowstone River at:
description 148–149
discharge, monthly 150
gage heights 149–150
rating table 150
Glenrock, Wyo.,
Deer Creek at:
discharge 294
Golden, Colo.,
Clear Creek at or near:
discharge 272, 295
Goldhill, Colo.,
Left Hand Creek near:
discharge 296
Grand River at—
Haley, N. Dak.: Page.
description 220
discharge 220
gage heights 221
Grand River basin:
stream flow 220–221
Grant, Colo.,
Geneva Creek near:
description 269–270
discharge 270, 294
discharge, monthly 271
gage heights 270
rating table 270
Scott-Gomer Creek at:
discharge 295
South Platte River (North Fork) at:
discharge 294
Threemile Creek at:
discharge 295
Guernsey, Wyo.,
North Platte River at:
description 230–231
discharge 231
discharge, daily 234
discharge, monthly 234
gage heights 232
rating table 233

H.

Haley, N. Dak.,
Grand River at:
description 220
discharge 220
gage heights 220
Hardin, Mont.,
Bighorn River near:
description 182–183
discharge 183
discharge, monthly 185
gage heights 183–184
rating tables 184–185
Harlem, Mont.,
Agency ditch near:
description 133
discharge 133
gage heights 134
Harlem canal near—
Zurich, Mont.:
description 132
discharge 132
discharge, monthly 133
gage heights 132
Harlowton, Mont.,
American Fork near:
description 100
discharge 100
discharge, monthly 102
gage heights 101
rating tables 102
Lebo Creek near:
description 103
discharge 103
gage heights 103–104
Musselshell River at:
description 94–95
discharge 95

Digitized by Google

Harlowton, Mont.—Continued.
Musselshell River at—Continued. Page.
discharge, daily ... 96
discharge, monthly ... 96
gage heights ... 95
rating tables ... 95
Havre, Mont.,
Milk River at:
description ... 108-109
discharge ... 109-110
discharge, daily ... 111-112
discharge, monthly ... 112
gage heights ... 110-111
Heart River basin:
description ... 211
gaging station ... 211
miscellaneous measurements ... 293
stream flow ... 211-216
Heart River at or near—
Big Bend, N. Dak.:
discharge ... 293
Mandan, N. Dak.:
discharge ... 293
Richardton, N. Dak.:
description ... 214
discharge ... 214
discharge, monthly ... 216
gage heights ... 215
rating table ... 216
Helena, Mont.,
Sevenmile Creek near:
description ... 47
discharge ... 48
gage heights ... 48
Tenmile Creek near:
description ... 46
discharge ... 46
discharge, monthly ... 47
gage heights ... 47
rating table ... 47
Henshaw, F. F., work of ... 30
Hessie, Colo.,
Middle Boulder Creek (North Fork) at:
discharge ... 295
Hinsdale, Mont.,
Milk River at:
description ... 116
discharge ... 116
discharge, monthly ... 117
gage heights ... 117
rating table ... 117
Rock Creek canal near:
description ... 137
discharge ... 137
gage heights ... 137
Rock Creek near:
description ... 125
discharge ... 125
discharge, monthly ... 126
gage heights ... 125
rating table ... 126
Houston, Mo.,
Gasconade River (Piney Fork) near:
description ... 291
discharge ... 291
gage heights ... 291
Huch, A. F., work of ... 29
Hudson, Wyo.,
Little Popo Agie River at or near: Page.
description ... 191-192
discharge ... 192, 292
discharge, monthly ... 194
gage heights ... 192-193
rating tables ... 193
Popo Agie River at:
discharge ... 292
Huntley, Mont.,
Pryor Creek at:
description ... 175
discharge ... 176
discharge, monthly ... 177
flood, view ... 144
gage heights ... 176-177
rating table ... 177
Yellowstone River at:
description ... 144
discharge ... 144
discharge, monthly ... 146
gage heights ... 145
rating table ... 146
Huntley project, views on ... 144

I.

Ice, measurements under ... 21, 27
Indian Creek:
discharge ... 293
Indian Creek (East Fork):
discharge ... 293
Indian Creek (West Fork):
discharge ... 293
Interstate canal, views on ... 224, 226
Investigations, authority for ... 7
purposes of ... 9-10
scope of ... 8-9
Irrigation, stream flow and ... 9

J.

Jasper Creek mouth,
Middle Boulder Creek (South Fork) near:
discharge ... 295
Jasper Creek reservoir,
Middle Boulder Creek (South Fork) near:
discharge ... 295
Jenny Creek near—
Black Hills ditch, Colo.:
discharge ... 296
J. K. ranch, Wyo.,
Bull Lake Creek at:
discharge ... 292
Meadow Creek at:
discharge ... 292
Willow Creek at:
discharge ... 292
Julesburg, Colo.,
South Platte River near:
description ... 265-266
discharge ... 266
discharge, monthly ... 267
gage heights ... 266-267
rating tables ... 267
Junction, Mont.,
Yellowstone River at:
description ... 146-147
discharge ... 147

Digitized by Google

Junction, Mont.—Continued.
Yellowstone River at—Continued. Page.
discharge, monthly 148
gage heights 147
rating table 148

K.

Kansas River basin:
description 282-284
gaging stations 284
miscellaneous measurements 296
stream flow 284-289
Keplers Cascade, view of 30
Kersey, Colo.:
South Platte River near—
description 259-200
discharge 260, 262
discharge, daily 264
discharge, monthly 265
gage heights 261, 263
rating table 262, 264
Knife River at—
Broncho, N. Dak.,
description 210
discharge 210
discharge, daily 212
discharge, monthly 213
gage heights 211
rating tables 212
Knife River basin:
description 209
gaging station 209
stream flow 209-213

L.

Lander, Wyo.:
Baldwin Creek at—
discharge 292
Popo Agie River near:
discharge 292
Popo Agie River (North Fork) at:
discharge 292
Squaw Creek at:
discharge 292
La Prele Creek at—
Douglas, Wyo.:
discharge 294
Fetterman, Wyo.:
discharge 294
Lebo Creek near—
Harlowton, Mont.:
description 103
discharge 103
gage heights 103-104
Left Hand Creek at or near—
Goldhill, Colo.:
discharge 296
Ward, Colo.:
discharge 296
Lima, Mont.,
Red Rock River at:
description 33
discharge 33
harge, monthly 34
heights 34
ıg table 34
Little Blue River near—
Fairbury, Nebr.: Page.
description 287-288
discharge 288
discharge, daily 289
discharge, monthly 289
gage heights 288
rating tables 289
Little Bordeaux Creek:
discharge 293
Little Heart River at—
Little Heart, N. Dak.:
discharge 293
Little Missouri River at—
Medora, N. Dak.:
description 206
discharge 206
discharge, monthly 209
gage heights 207
rating tables 206
Little Missouri River basin:
description 205-206
gaging stations 206
stream flow 206-209
Little Muddy River basin:
description 201-202
stream flow 202-205
Little Muddy River near—
Williston, N. Dak.:
description 202
discharge 203
discharge, monthly 204-205
gage heights 203-204
rating table 204
Little Popo Agie River at or near—
Hudson, Wyo.:
description 191-192
discharge 192, 292
discharge, monthly 194
gage heights 192-193
rating tables 193
Little Porcupine basin:
stream flow 138
Little Porcupine Creek near—
Frazer, Mont.:
description 138
discharge 138
gage heights 138
Little Wind River at or near—
(above) Arapahoe, Wyo.:
description 186
discharge 186
discharge, monthly 188
gage heights 187
rating tables 188
(below) Arapahoe, Wyo.:
description 189
discharge 189
discharge, monthly 191
gage heights 190
rating tables 191
Fort Washakie, Wyo.:
description 185
discharge 186
gage heights 186
Longmont, Colo.,
St. Vrains Creek at:
discharge 295

Digitized by Google

Page.

Los Angeles, Cal., rating station at, view of... 18
Loup River at—
Columbus, Nebr.:
description... 245
discharge... 246
gage heights... 246-247
Lump Gulch Creek near—
Clancy, Mont.:
description... 45
discharge... 45
gage heights... 46
Lynch, Nebr.—
Ponca Creek at:
discharge... 294

M.

McLeod, Mont.—
Boulder Creek at:
discharge... 292
Boulder River (East Fork) near:
description... 156
discharge... 156
discharge, monthly... 158
gage heights... 156-157
rating table... 157
Boulder River (West Fork) at:
description... 163
discharge... 163
discharge, monthly... 165
gage heights... 163-164
rating tables... 164-165
Malta, Mont.—
Milk River at:
description... 113
discharge... 113
discharge, daily... 115
discharge, monthly... 116
gage heights... 114
rating table... 115
Mandan, N. Dak.—
Heart River at:
discharge... 293
Marias River basin:
description... 72-73
gaging station... 73
stream flow... 73-91
Marias River near—
Shelby, Mont.:
description... 76-77
discharge... 77
discharge, daily... 78
discharge, monthly... 78
discharge curves, chart... 24
gage heights... 77
rating tables... 78
Marquette, Wyo.—
Shoshone River (North Fork) at:
discharge... 292
Shoshone River (South Fork) at:
description... 199
discharge... 199
discharge, daily... 201
discharge, monthly... 201
gage heights... 199-206
rating tables... 200

Page.

Marshall, Colo.,
South Boulder Creek at:
discharge... 296
Martinsdale, Mont.,
Musselshell River (North Fork) near:
description... 92
discharge... 92
discharge, monthly... 94
gage heights... 93
rating table... 94
Musselshell River (South Fork) near:
description... 98
discharge... 98
discharge, monthly... 100
gage heights... 98-99
rating tables... 99
Mathers, J. G., work of... 30
Matheson canal near—
Chinook, Mont.:
description... 131
discharge... 131
discharge, monthly... 132
gage heights... 131
Meadow Creek at—
J. K. ranch, Wyo.:
discharge... 292
Medora, N. Dak.,
Little Missouri River at:
description... 206
discharge... 206
discharge, monthly... 209
gage heights... 207
rating tables... 208
Meeker, R. I., work of... 29
Melville, Mont.,
Sweetgrass Creek above:
description... 165-166
discharge... 166
discharge, daily... 168
discharge, monthly... 169
gage heights... 166-167
rating tables... 167-168
Sweetgrass Creek below:
description... 169
discharge... 169
discharge, daily... 171
discharge, monthly... 172
gage heights... 170
rating tables... 171
Middle Boulder Creek (North Fork) at—
Hessie, Colo.:
discharge... 295
Middle Boulder Creek (South Fork) near—
Jasper Creek mouth:
discharge... 295
Jasper Creek reservoir:
discharge... 295
Milford, Wyo.,
Popo Agie River (North Fork) at:
discharge... 292
Milk River at—
Havre, Mont.:
description... 108-109
discharge... 109-110
discharge, daily... 111-112
discharge, monthly... 112
gage heights... 110-111

Digitized by Google

Milk River at—Continued. Page.
Hinsdale, Mont.:
description 116
discharge 116
discharge, monthly 117
gage heights 117
rating table 117
Malta, Mont.:
description 113
discharge 113
discharge, daily 115
discharge, monthly 116
gage heights 114
rating table 115
Milk River basin:
canals 127–137
description 104–105, 127
gaging stations 106, 128
stream flow 106–127
Milk River (North Fork) near—
Chinook, Mont.:
description 120
discharge 120–121
discharge, daily 123
discharge, monthly 123
gage heights 121–122
rating table 122
Milk River (South Fork) near—
Browning, Mont.:
description 106
discharge 106
discharge, monthly 108
gage heights 107
rating tables 108
Milk River (West Fork) at—
Chinook, Mont.:
description 117–118
discharge 118
discharge, daily 119
discharge, monthly 120
gage heights 119
Miner's inch, definition of 14
Miscellaneous measurements:
Bighorn River basin 292
Cannon Ball River basin 293
Heart River basin 293
Kansas River basin 296
minor Missouri River drainage in Nebraska 294
Niobrara River basin 293
North Platte River basin 294
Platte River basin 294
South Platte River basin 294–296
Upper Missouri River basin 291
White River basin 293
Yellowstone River basin 292
Missouri River at or near—
Cascade, Mont.:
description 38
discharge 38
discharge, monthly 41
gage heights 39
rating tables 40
Williston, N. Dak.:
description 41
discharge 41
discharge, monthly 42
gage heights 42
rating table 42
Missouri River basin (proper): Page.
description 31–32
gaging stations 32
miscellaneous measurements 291, 294
stream flow 33–42
Missouri River drainage:
description 30–31
miscellaneous measurements 291–296
stream flow 31–296
Mitchell, Nebr.,
North Platte River near:
description 234–235
discharge 235
discharge, daily 237
discharge, monthly 237
gage heights 235–236
rating tables 236
Mollies Fork, interstate canal waste at, view of 226
Montana, cooperation of 29
Morrison, Colo.,
Bear Creek at:
discharge 295
Mott, N. Dak.,
Cannon Ball River (North Fork) at:
discharge 293
Musselshell River at or near—
Harlowton, Mont.:
description 94–95
discharge 95
discharge, daily 96
discharge, monthly 96
gage heights 95
rating tables 96
Shawmut, Mont.:
description 97
discharge 97
gage heights 97
Musselshell River basin:
description 91–92
gaging stations 92
stream flow 92–104
Musselshell River (North Fork) near—
Martinsdale, Mont.:
description 92
discharge 92
discharge, monthly 94
gage heights 93
rating table 94
Musselshell River (South Fork) near—
Martinsdale, Mont.:
description 98
discharge 98
discharge, monthly 100
gage heights 98–99
rating tables 99

N.

Nashua, Mont.,
Porcupine Creek at:
description 126–127
discharge 127
gage heights 127
Navigation, stream flow and 9
Nebraska, cooperation of 29
Nehawka, Nebr.,
Weeping Water Creek at:
discharge 294

Digitized by Google

New England, N. Dak.,
Cannon Ball River (North Fork) at: Page.
discharge.... 293
Niobrara, Nebr.,
Bazile Creek at:
discharge.... 294
Verdigris Creek at:
discharge.... 293
Niobrara River basin:
description.... 221-222
gaging stations.... 222
miscellaneous measurements.... 293
stream flow.... 222-223
Niobrara River near—
Spencer, Nebr.:
description.... 222
discharge.... 222
gage heights.... 223
Norfolk, Nebr.,
Elkhorn River (North Fork) at:
discharge.... 294
North Boulder Creek at—
Boulder Co. ranch:
discharge.... 295
North Platte, Nebr.,
South Platte River at:
discharge.... 294
North Platte project, views at.... 224, 226
North Platte River at or near—
Bridgeport, Nebr.:
discharge.... 294
Guernsey, Wyo.:
description.... 230-231
discharge.... 231
discharge, daily.... 234
discharge, monthly.... 234
gage heights.... 232
rating tables.... 233
Mitchell, Nebr.:
description.... 234-235
discharge.... 235
discharge, daily.... 237
discharge, monthly.... 237
gage heights.... 235-236
rating tables.... 236
North Platte, Nebr.:
description.... 237-238
discharge.... 238
discharge, daily.... 239-240
discharge, monthly.... 240
gage heights.... 238-239
Pathfinder, Wyo.:
dam, view.... 224
description.... 227
discharge.... 227
discharge, monthly.... 230
gage heights.... 228-229
rating table.... 229
North Platte River basin:
description.... 223-226
gaging stations.... 226-227
miscellaneous measurements.... 294
stream flow.... 227-240

O.

Oak Creek:
discharge.... 294
Office practice, methods of.... 21-27
Orodell, Colo.,
Boulder Creek at: Page.
description.... 275
discharge.... 276
discharge, daily.... 278
discharge, monthly.... 278
gage heights.... 276-277
rating table.... 277

P.

Padgett, H. D., work of.... 30
Paradise Valley, canal near—
Chinook, Mont.:
description.... 128
discharge.... 128
discharge, monthly.... 129
gage heights.... 129
Pathfinder, Wyo.,
North Platte River at:
dam, view.... 224
description.... 227
discharge.... 227
discharge, monthly.... 230
gage heights.... 228-229
rating table.... 229
Perigo ditch at—
Rollinsville, Colo.:
discharge.... 296
Pierce, Nebr.,
Elkhorn River (North Fork) at:
discharge.... 294
Pierson, J. B., work of.... 29
Piney Fork. *See* Gasconade River (Piney Fork).
Platte River at—
Columbus, Nebr.:
description.... 242
discharge.... 242
discharge, monthly.... 245
gage heights.... 243
rating tables.... 244
Fremont, Nebr.:
discharge.... 294
Platte River basin:
description.... 223
miscellaneous measurements.... 294
stream flow.... 223-282
Platte River basin (proper):
description.... 241
gaging stations.... 241-242
stream flow.... 242-247
Plum Creek at—
Sedalia, Colo.:
discharge.... 295
Toluca, Colo.:
discharge.... 295
Ponca Creek at—
Lynch, Nebr.:
discharge.... 294
Spencer, Nebr.:
discharge.... 294
Poplar Creek basin:
stream flow.... 140
Poplar Creek near—
Poplar, Mont.:
description.... 140
discharge.... 140
gage heights.... 140

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Page.

Ram, L. C., work at 8
Rapanui, Matthews, work at 9
Reservoir, A. Dan,
  Bear River
    description 54
    discharge 54
    discharge, monthly 55
    gage-heights 57
    rating table 56
Reservoir, F. W.,
  Big Wind River
    description 56
    discharge 56
    discharge, monthly 56
    gage-heights 56
    rating table 56
  [illegible]
    discharge 56
  [illegible]
  Rhinestone River
    description 54
    discharge 54
    gage-heights 54
  [illegible]
  Riverside River
    description 55
    discharge 55
    discharge, monthly 55
    gage-heights 55
    rating table 55
  [illegible]
    [illegible] 56
  [illegible]
  [illegible]
    [illegible] 56
  [illegible]
    [illegible] 56
  [illegible]
    [illegible] 56

Shelby, Mont.—Continued.
Marias River near—Continued. Page.
discharge, monthly 78
discharge curves, chart 24
gage heights 77
rating table 78
Shoshone project, views at 180, 196
Shoshone River at—
Cody, Wyo.:
description 194
discharge 194
discharge, monthly 197
gage heights 195
rating tables 196
Corbett dam, Wyo.:
description 197
discharge, monthly 198
gage heights 198
rating table 198
view 196
Shoshone River (North Fork) at—
Marquette, Wyo.:
discharge 292
Shoshone River (South Fork) at—
Marquette, Wyo.:
description 199
discharge 199
discharge, daily 201
discharge, monthly 201
gage heights 199–200
rating tables 200–201
Slope method, description of 16
Smith Creek near—
Augusta, Mont.:
description 69
discharge 69
discharge, monthly 72
discharge curves, chart 23
gage heights 70
rating tables 71
Smith River at—
Truly, Mont.:
description 50
discharge 51
discharge, monthly 52
gage heights 51
rating table 51
Smith River basin:
stream flow 50–52
South Boulder Creek at—
Marshall, Colo.:
discharge 296
Tolland, Colo.:
discharge 296
South Platte, Colo.,
South Platte River (North Fork) at:
discharge 294
South Platte River at or near—
Fort Morgan, Colo.:
discharge 294
Julesburg, Colo.:
description 265–266
discharge 266
discharge, monthly 267
gage heights 266–267
rating tables 267
South Platte River at or near—Continued.
Kelsey, Colo.: Page.
description 259–260
discharge 260, 262
discharge, daily 264
discharge, monthly 265
gage heights 261, 263
rating tables 262, 264
North Platte, Nebr.:
discharge 294
South Platte, Colo.:
description 255–256
discharge 256
discharge, daily 258
discharge, monthly 259
gage heights 257
rating tables 258
Union, Colo.:
discharge 294
South Platte River basin:
description 247–250
gaging stations 251
miscellaneous measurements 294–296
stream flow 251–282
South Platte River (North Fork) at—
Cassels, Colo.:
description 268
discharge 268, 294
discharge, monthly 269
gage heights 268
rating table 269
Grant, Colo.:
discharge 294
South Platte, Colo.:
discharge 294
South Platte River (South Fork) at—
South Platte, Colo.:
description 251–252
discharge 252
discharge, daily 254
discharge, monthly 255
gage heights 252–253
rating tables 253–254
Spencer, Nebr.,
Niobrara River near:
description 222
discharge 222
gage heights 223
Ponca Creek at:
discharge 294
Squaw Creek at—
Lander, Wyo.:
discharge 292
Stagner's ranch, Wyo.,
Big Wind River at:
discharge 292
Stevens, G. C., work of 30
Stevenson, N. Dak.,
Cannon Ball River at:
description 217–218
discharge 218
discharge, monthly 220
gage heights 218–219
rating table 219
Dogtooth Creek near:
discharge 293
Stewart, J. B., work of 29

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Page.

Stewart, J. E., work of..... 29, 30
Stream measurements, accuracy of..... 27–28
data of, use of..... 28–29
methods of..... 16–21
Sun River at—
Sun River, Mont.:
description..... 56
discharge..... 56
discharge, daily..... 59
discharge, monthly..... 59–60
gage heights..... 57
rating tables..... 58
Sun River basin:
description..... 52–53
gaging stations..... 53
stream flow..... 53–72
Sun River canyon, view in..... 52
Sun River (North Fork) near—
Augusta, Mont.:
description..... 53
discharge..... 54
discharge, monthly..... 56
gage heights..... 54–55
rating tables..... 55
Sun River (South Fork) at—
Augusta, Mont.:
description..... 60
discharge..... 60
discharge, monthly..... 62–63
gage heights..... 61
rating tables..... 62
Sunshine, Colo.,
Boulder Creek at:
discharge..... 295
Swamps, drainage of, stream flow and..... 9–10
Sweetgrass Creek near—
(above) Melville, Mont.:
description..... 165–166
discharge..... 166
discharge, daily..... 168
discharge, monthly..... 169
gage heights..... 166–167
rating tables..... 167–168
(below) Melville, Mont.:
description..... 169
discharge..... 169
discharge, daily..... 171
discharge, monthly..... 172
gage heights..... 170
rating tables..... 171

T.

Tables, explanation of..... 15–16
Tenmile Creek near—
Helena, Mont.:
description..... 46
discharge..... 46
discharge, monthly..... 47
gage heights..... 47
rating table..... 47
Terms, definitions of..... 14–15
Teton River near—
Bellevew, Mont.:
description..... 89–90
discharge..... 90

Page.

Teton River near—Continued.
Belleview, Mont.—Continued.
discharge, monthly..... 91
gage heights..... 90
rating table..... 90
Threemile Creek at—
Grant, Colo.:
discharge..... 296
Tolland, Colo.,
Black Hills ditch at:
discharge..... 296
Continental divide near:
view..... 250
South Boulder Creek at:
discharge..... 296
Toluca, Colo.,
Plum Creek at:
discharge..... 295
Trout Creek at—
Wind River, Wyo.:
discharge..... 292
Truly, Mont.,
Smith River at:
description..... 50
discharge..... 51
discharge, monthly..... 52
gage heights..... 51
rating table..... 51
Two Medicine River at—
Family, Mont.:
description..... 79
discharge..... 79
discharge, monthly..... 81
gage heights..... 79–80
rating tables..... 80–81

U.

Union, Colo.,
South Platte River at:
discharge..... 254

V.

Velocity method, description of..... 17–21
Verdigris Creek at—
Niobrara, Nebr.:
discharge..... 293
Verdigris, Nebr.:
discharge..... 293

W.

Wahoo Creek at—
Ashland, Nebr.:
discharge..... 294
Walters, M. I., work of..... 30
Ward, Colo.,
Left Hand Creek near:
discharge..... 296
Water power, stream flow and..... 9
Water supply, stream flow and..... 9
Weather Bureau, cooperation of..... 29
Weeping Water Creek at—
Nehawka, Nebr.:
discharge..... 294
Weir method, description of..... 16–17
White River:
discharge..... 293

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White River basin: Page.
miscellaneous measurements..... 293
Wilber, Nebr.,
Blue River at:
discharge..... 299
Williston, N. Dak.,
Little Muddy River near:
description..... 202
discharge..... 203
discharge, monthly..... 204–205
gage heights..... 203–204
rating table..... 204
Missouri River near:
description..... 41
discharge..... 41
discharge, monthly..... 42
gage heights..... 42
rating table..... 42
Willow Creek at or near—
Augusta, Mont.:
description..... 63
discharge..... 63
discharge, monthly..... 65–66
gage heights..... 64
rating tables..... 65
Belleville, Mont.:
discharge..... 291
Willow Creek at—
J. K. ranch, Wyo.:
discharge..... 292
Wind River, Wyo.,
Trout Creek at:
discharge..... 292
Winter-Anderson canal near—
Chinook, Mont.:
description..... 136
discharge..... 136
discharge, monthly..... 137
gage heights..... 136
Wolf Creek at—
Wolf Point, Mont.:
description..... 139
discharge..... 139
gage heights..... 139
Wolf Creek basin:
stream flow..... 139
Wolf Point, Mont., Page.
Wolf Creek at:
description..... 139
discharge..... 139
gage heights..... 139
Wood, B. D., work of..... 30
Work, division of..... 29–30
Wyoming central canal at—
Riverton, Wyo.:
discharge..... 292

Y.

Yellowstone (Lower) project, canal of, views of..... 148
Yellowstone River, lower falls of, view of..... 142
Yellowstone River at—
Glendive, Mont.:
description..... 148–149
discharge, monthly..... 150
gage heights..... 149–150
rating table..... 150
Huntley, Mont.:
description..... 144
discharge..... 144
discharge, monthly..... 146
gage heights..... 145
rating table..... 146
Junction, Mont.:
description..... 146–147
discharge..... 147
discharge, monthly..... 148
gage heights..... 147
rating table..... 148
Yellowstone River basin:
description..... 141–143
gaging stations..... 143–144
miscellaneous measurements..... 292
stream flow..... 144–201

Z.

Zurich, Mont.,
Harlem Canal near:
description..... 132
discharge..... 132
discharge, monthly..... 133
gage heights..... 132

O

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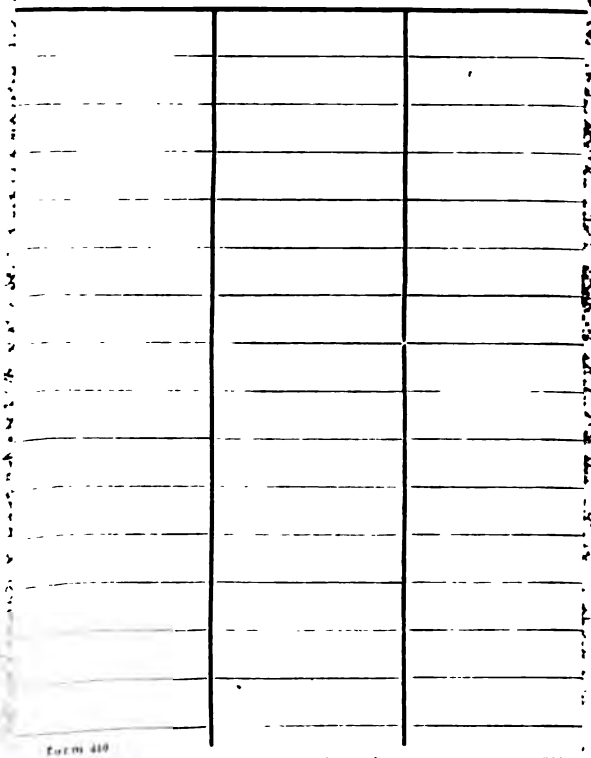

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